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THE SCOTTISH
GEOGRAPHICAL
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THE BLACK ISLE, ROSS-SHIRE

A LAND USE STUDY

JAMES B. CRUICKSHANK

The Black Isle has long had a reputation as one of the most fertile tracts of land in Scotland. Its name derives from the usually snow-free landscape which this sheltered peninsula, encompassed by arms of the Moray Firth, presents in winter. Its agricultural fertility is however only relative to the adjacent North-west Highlands. Nevertheless, the Black Isle is an oasis between the rugged hills and the open sea; approached from the west, its lowlands make a striking change in landform. From the arrival of the first farming folk to Scotland in Neolithic times to the more recent phases of Highland emigration, men have come from the west, from the Great Glen routeway and remote hill crofts. They have come long and far to work the soils of the Black Isle, and the use they have made of the land is the purpose of this study.

The Black Isle is a peninsula between the Cromarty and Moray Firths, (Fig. 1). It measures about twenty miles in length, and is eight miles wide in the south-west, narrowing to four miles at Rosemarkie and to less than two miles near the tip of Cromarty. Just over 100 square miles in area, its limits are defined by the sea and, at its land junction, by the almost co-incident boundaries of the main A9 road and the western edge of the Old Red Sandstone till. The peninsula is a parallelogram of land with a north-east to south-west long axis; and its morphology reflects the Caledonian strike of the underlying strata and of the main fault on which the south-east face abuts. In Figure 1, the north-east to south-west corrugations can be seen rising to about 400 feet on the central Mount Eagle-Millbuie ridge and on the north-east coastal block of granitic gneiss. Although there is little variation in relief, there is a distinctive contour pattern that is partly explained by the underlying geological structure.

The greater part of the peninsula, and the coastal lowlands beyond the Cromarty and Moray Firths, are composed of Middle Old Red Sandstone strata laid down in Devonian Lake Orcadie [1]. In the Black Isle, red, yellow and grey sandstone strata lie in synclinal formation, generally dipping at an angle between 5 and 10 degrees, with the crest

of the Mount Eagle ridge marking the axis of the trough [2]. The angle of dip increases towards the main fault, particularly in the south-east where the basal beds of Old Red Sandstone conglomerate are exposed and dip west-north-west at 15-25 degrees in the highest beds, and 68-70 degrees in the basal beds adjacent to the main fault. In the north-east, the sandstone beds rest on two blocks of Moinian granitic gneiss that have been upfaulted to expose the ancient floor of the crystalline rocks.

The smoothed topography of the peninsula and the character of the superficial deposits are evidence that the Black Isle has been affected by regional glaciation. While most of lower land is deeply covered by glacial till, the Mount Eagle ridge, the basal conglomerate hills around Kessock, and the faulted, more resistant gneissic rocks, have only a veneer of drift. In association with the till, the Geological Survey records fluvio-glacial sand and gravel, morainic drift and kettle-hole peat, raised-beach deposits and alluvium, on the published maps of the glacial drift of the Black Isle peninsula. On these, the distribution map of the superficial deposits (Fig. 2) has been based, with an additional subdivision between two types of Old Red Sandstone till. This latter distinction is described indirectly in the *Statistical Accounts*, and it is well known to local farmers that the sub-soil on the north-facing slope near Cromarty is redder in colour and is of a heavier loam texture than the sandy till of the rest of the peninsula. There is a strong argument for the separation of these two Old Red Sandstone tills. The problem is whether they have originated from separate glaciations, or whether they owe their difference to comparable differences in the Old Red Sandstone strata, from which they have been derived and glacially reworked.

Despite the occurrence of calcareous bands in the sandstone, both tills are naturally acid. They contain erratic stones, appearing with equal frequency in both tills, that have been brought from the acid, crystalline, Highland rocks to the west. Glacial striae, although not well-preserved, show a remarkable consistency in direction. Most were plotted on Old Red Sandstone and the maximum variation in bearing is only 18 degrees, from East 12 degrees North to East 30 degrees North. The direction of the striae and the similarity of the erratic stone-content of both tills would support the thesis that they were developed by the same regional glaciation.

On the other hand, the discontinuous distribution of patches of the heavier textured loam-till, west of the main area near Cromarty, would suggest that these are remnants of a formerly widespread till that has been subsequently overlain from the west by the sandier material. There are exposures to support this sequence. If the sandy till is the product of a later glacial advance, it would be reasonable to expect some topographic terminal feature. None exists. There is no margin of morainic material at the junctions of the two tills. It is difficult to postulate a glacial re-advance without re-advance moraines. J. K. Charlesworth [3] has suggested a terminal zone from Culbokie to Kessock for the Perth re-advance, but field investigations provided no surface or sub-soil evidence to corroborate this.

Any attempt to date the deposition of these Old Red Sandstone tills

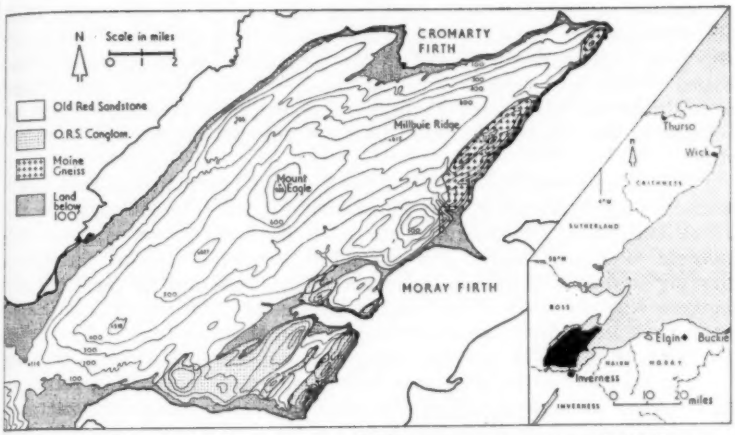


Fig. 1. The Black Isle : location and physique; contour interval 100 feet.

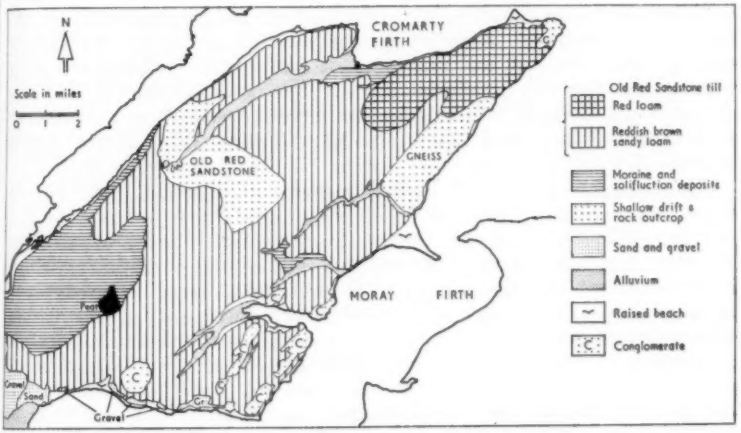


Fig. 2. The Black Isle : superficial deposits.

Figs. 1 and 2 are based on the published maps of the Ordnance Survey and the Geological Survey of Scotland. They are Crown Copyright, and published by permission of the Controller of Her Majesty's Stationary Office.

would be related to the last two glaciations of the area, the Highland and Perth Re-advances of the late Würm. In the absence of any terminal moraines, it is probable that the Perth Re-advance ice passed over the entire peninsula and terminated somewhere in the Moray Firth. This corresponds with Synge's views on the glacial sequence for North-east Scotland [4] in which the terminal moraines of the Perth Re-advance were mapped parallel to, and a few miles west of, the River Spey. The Perth Re-advance Moray Firth ice was probably responsible for the

deposition of both Old Red Sandstone tills, and its decay would have left the sporadic mounds of sand and gravel, and the kame and kettle topography near the west end of the peninsula. In this Monad Mhor district, there is a change from the sandy till into a stony and coarse sandy material. This is not fluvioglacial gravel, but apparently a coarser version of the till. It is mapped by the Geological Survey as morainic drift.

The natural soils of acid tills in the Highland area are podsols, peaty podsols with iron pan, gleyed series of these, and blanket peat. In the Black Isle, the dry climate and low relief have not favoured the development of climatic peat. The present semi-natural soils of the rough grazing land and the forestry plantations have had most of their organic horizon stripped for turf fuel during the centuries of occupation. These soils have little humified organic matter in their surface horizon, but have the lower-profile characteristics of iron podsols and peaty podsols.

The land utilisation of an area with fairly uniform climatic conditions is, however, influenced more by drainage conditions and parent material than by the soil type. Only a fraction of the soil is freely drained, and slope allowing lateral drainage usually determines its occurrence. These freely drained soils cover about a third of the total area and are to be found on the steeper slopes of the central ridge and on the conglomerate hills in the south-east. A much greater area is covered by imperfectly drained soils, showing the first signs of mottling due to a fluctuating water table. They occur in areas having little or no gradient, where the drainage has become impeded by the development of an iron pan or an impervious indurated layer. The alluvial areas (Fig. 2) are poorly drained gleys or peaty gleys.

The variable success of arable farming, in different parts of the Black Isle, supports the sub-division of the agricultural soils on the Old Red Sandstone till into two types. The more fertile soils, with better structure and loam texture, are the red soils on the north-facing slope near Cromarty. There, the higher natural fertility, larger farm-size and field-size are reflected in more intensive cropping and higher yields. Eighteenth-century estate maps — discussed later — show that infield cultivation in the Black Isle was most extensive in this area, while agricultural records since 1884 indicate that the parish of Cromarty has returned the highest crop yields per acre for all crops in all parishes in the peninsula. However, the natural fertility of all soils is low by national standards and careful management with artificial fertilisers is necessary to maintain crop yields. Serious trace-element deficiency in the soils is not limited to any one district.

The evolution of a pattern of land utilisation in any area must be influenced, to some extent, by the physical factors of climate, relief, geology and soil. In this respect, the Black Isle is no exception, but equally significant are the social changes that have taken place within the area.

The location of the Black Isle peninsula, focal to all the natural routeways in its region, has meant a long history of occupation. In Neolithic times, the Great Glen corridor channelled those Megalithic people moving from their coastal settlements in south-west Scotland towards the northern isles [5]. The Moray Firth lowlands would have

provided a major halting place on this migration route, and ultimately they became the northern basin of two rival Megalithic cultures. The Clava group from the Nairn valley and the Pentland group, colonising from Caithness, met within the Black Isle peninsula. Here, most of the evidence of pre-historic occupation is in the chambered cairns of the Pentland type, described by Childe [6] and Woodham [7]. They are found in association with hut sites and enclosures, in all cases located on dry sites between 200 and 600 feet on the northern slopes of the axial ridge, and on the conglomerate hills in the south-east. These sites were certainly occupied into the Bronze age and later. The areas settled, grazed and worked by the first farmers have shallow, sandy soils on freely drained sites. The greater part of the peninsula, where drainage is imperfect, would have remained untouched, and the natural woodland unfelled.

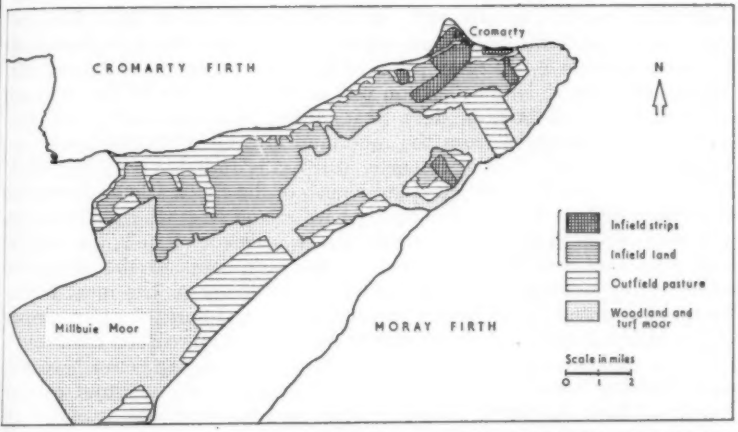


Fig. 3. The old Cromarty estate, the Black Isle; simplified land utilisation divisions based on the 1764 estate map, drawn by David Aitken for the proprietor, Lord Elibank, and reproduced by permission of Colonel Ross, Cromarty House.

For long after the Bronze age, there was no definable use of the land. The north-west and Millbuie ridge near Cromarty were settled for a time by visiting Norse in the ninth century, but evidence of the increasing use of the land in mediaeval times, and later, is scant. The existence of about twelve pre-Reformation Chapels — there were six in the parish of Cromarty — and the more important ecclesiastical settlement around Fortrose Cathedral is well known, but it is only within the last two centuries that changes in land use can be examined in detail.

At the start of the eighteenth century, the Black Isle presented a landscape and a social structure that could be considered an enclave of lowland Scotland within the Highlands. The people were Protestant and English speaking. The Gaelic language was seldom heard. Many of the landed proprietors had come from the south, and all supported the Imperial Government. At this time, the peninsula was divided into

fifteen estates and approximately the same number of smaller properties. None was affected by reprisals following the Jacobite rebellions. No attempt had been made to improve or to enclose the estate land, and agriculture was at a subsistence level. Most of the woodland had been cleared for fuel, and although the arable acreage was increasing during this century, less than one quarter of the total area was being cultivated in the seventeen-eighties.

The plan of the estate of Cromarty (Fig. 3), drawn for the proprietor, Lord Elibank, by David Aitken in 1764, shows the holding of the infield strips to have been fixed by that time. This fixing of tenure may have been exceptional for a Highland area in the mid-eighteenth century. It was well established around the village settlements of the Black Isle, and also at several 'ferm-touns' that have since disappeared — examples of the latter are preserved in the farm-names of Mickel Farnes and Navity. The Walter Macfarlane geographical descriptions of Scotland, 1720-1744, mention briefly only three of the six Black Isles parishes, and it is not until the last decade of the century that the *Old Statistical Accounts* provide a full description of land use in the area. During the eighteenth century, land utilisation was controlled partly by the demand for fuel. In the absence of deep peat, timber was cut freely, turf was systematically stripped from the moorland and all available moss was retrieved and dried. From Cromarty, 'turf roads' radiated over the bleak Millbuie common that stretched the length of the Black Isle and covered more than half its surface. Denuded of woodland, the Millbuie common was used as rough grazing for cattle and as a source of fuel. The arable land was confined to the coastal slopes peripheral to the common, infield being worked in runrig around the settlements. The most fertile land was reputed to be from Cromarty along the north-western slopes of the Millbuie ridge, an area described as an "uninterrupted cornfield". But here, and elsewhere, there were problems of draining heavy-textured soils, clearing stones from the fields and raising fertility without a local supply of lime. A limited supply of marl and seaweed was available as fertiliser. Farms were small and seldom had more than ten acres of infield. The fields were not fenced, and in winter must have appeared, and been used, as one large common land. There was no rotation grass, tillage crops being grown repeatedly to the exhaustion of the soil. Although oats, peas, potatoes and flax were grown, barley was the most common crop, supplying the many local distilleries.

At the end of the eighteenth century, the *Statistical Accounts* inform about certain improvements and changes in the use of the land [8]. Some of the waterlogged depressions had been drained, to avoid local flooding rather than to increase the arable acreage. A number of small farms had been fenced off, but these were only 20 to 80 acres in size and located on the smaller estates at the west of the peninsula. Some of the landlords had fenced sections of the moor, particularly for the planting of trees. In the period 1760-1790, the extension of woodland was recorded on the estates of Cromarty, Udale, Flowerburn near Rosemarkie, Findon, Belmadutby and Redcastle. These were numbered among the larger estates that, subsequently, were to lead agricultural improvement. A variety of trees was planted including a number of hardwoods, oak and alder especially. Conifers were the most common, and in all cases the

reason for planting was to provide a quick supply for the increasing demand for fuel.

The fencing and enclosing of the land began soon after this. Begun in the last years of the century, it was shown partly completed in the maps of 1813. By 1840, the field pattern was similar to the present. Tile drains were laid from 1849 onwards as part of large-scale soil drainage schemes. Previously, the estates had been portioned out into workable farm units varying in size according to the estate. At the west end of the peninsula, in the parishes of Killearnan and Knockbain, the farms were 20-80 acres, increasing to 150-200 acres in Avoch, Rosemarkie and Resolis, and to 300-500 acres in the parish of Cromarty, and the home farms of the original estates. Although the smaller estates, that now would be middle-size farm units of about 100 acres, were worked by their proprietor, most of the land was farmed by tenants, often on a short lease of only one to seven years. The arable land had been improved and enlarged, but the proportion of the total area was still small. The following percentages (Table 1), for four of the six parishes, are examples for the period 1840-1845.

Parish	Arable	Pasture	Woodland
Cromarty	30	45	25
Avoch	41	30	29
Knockbain	27	45	28
Killearnan	36	35	29

Table 1. Percentage land use in four Black Isle parishes.

Moorland and wasteland were classed with pasture, and the percentage of woodland included considerable tracts of plantation timber. The high land of the Moinian gneiss and the conglomerate hills had become the main areas of woodland.

The adoption of the six-course rotation of a cereal crop, root crop, and cereal again with a three-year grass ley, meant that the present farming practice had become established by the middle of the nineteenth century. The importance of small local distilleries declined and the barley acreage correspondingly decreased. Because of the initiative of a few farmers and the suitable climate, wheat became a popular grain crop in the period 1800-1850, particularly in the parish of Cromarty. The innovation was only temporary, and agricultural statistics show that from the eighteen-sixties oats has been the dominant cereal crop, followed by barley and wheat in almost equal proportions, and the combination of oats and grass gives the Black Isle its distinctive agricultural character as a cattle feeding and fattening district. Rotation grass had been introduced with the agricultural improvements, as part of the crop rotation, but to the end of the nineteenth century, for every acre sown in grass, two were ploughed for other crops. The low proportion of grass did not change in the rotation until after the 1914-18 war, when the acreage increased to 50 per cent of the arable. In common with the national trend, the total arable acreage decreased

in the same period, but the changes were small. The total arable acreage is now 5 per cent greater than in the eighteen-sixties. The crop rotation has settled to one of oats, turnips or potatoes, wheat or barley, followed by three years in ley grass.

The agricultural land is worked in farm units of varied size. The map of land-holding units (Fig. 5) includes built-up land, the golf course at Fortrose, and woodland blocks not in the farming unit. It demonstrates the varied pattern of farm size, the boundaries of many of the middle-size farms being adjusted to the structural trend of the peninsula, and all being related to the outlines of former estates. The influence of the estates has been carried into the parishes as these formerly comprised only two to five estates.

Farm Size in acres	1–15	15–50	50–100	100–300	over 300 acres
Cromarty	–	4	2	7	7
Rosemarkie	14	11	21	8	1
Resolis	21	29	25	14	3
Avoch	1	1	15	14	2
Knockbain	46	31	11	18	3
Killearnan	34	16	8	5	6

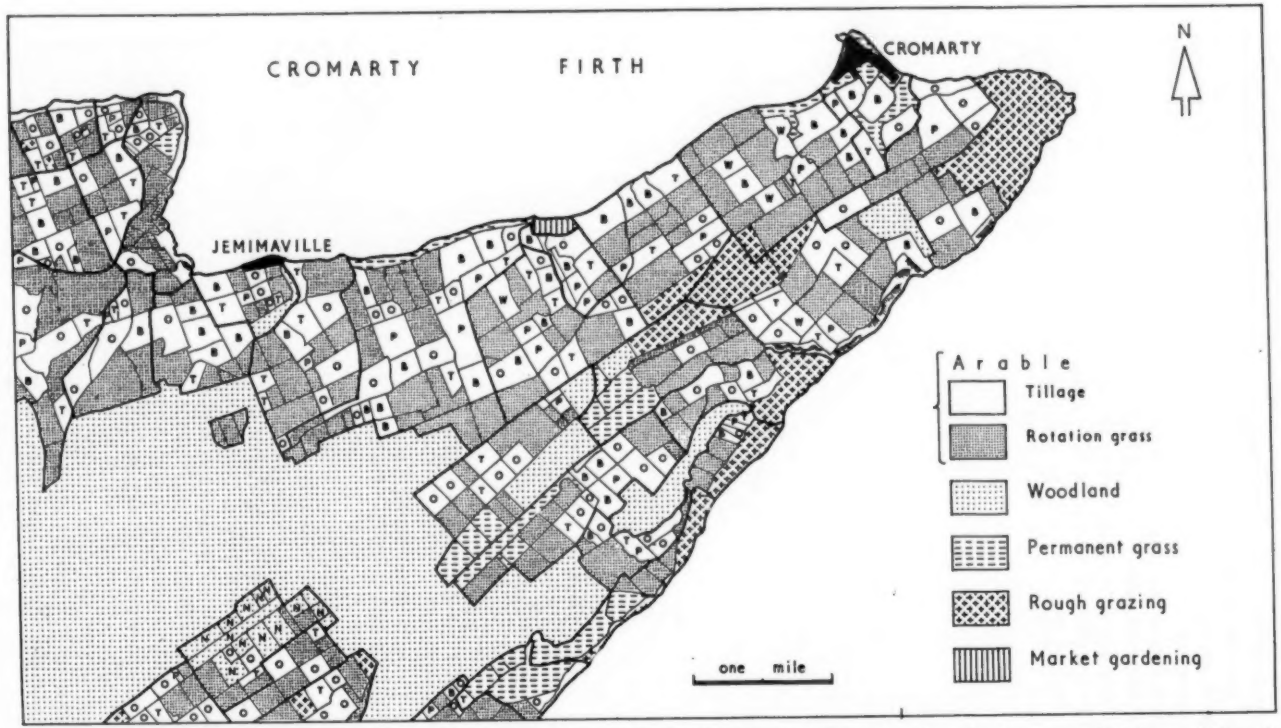
Table 2. Farm-size analysis in the Black Isle, 1958.

Statistics Supplied by Department of Agriculture for Scotland.

The parishes at the west end of the peninsula, Knockbain and Killearnan, as well as Resolis in the north, have the highest number of small farms (Table 2). These small holdings, units of 1-15 acres, are associated with the main road near the north-west shore, and in a block at the junction with the mainland. They were sited on previously uncultivated land as part of a planned resettlement of Highland crofters, particularly from Strathconon, in the eighteen-fifties. Both areas had been avoided as "moorish pasture", the soil being very poorly drained due to the presence of the indurated horizon near the surface. In the same parishes, one or two large farms were divided into 30-50 acre holdings as part of agricultural resettlement following the First World War. In contrast, the parishes of Cromarty and Avoch have a majority of farms over 100 acres. Most of the land in these two parishes was contained in the estates of Cromarty and Rosehaugh, incidentally the largest in the peninsula, and it may have been the area of land available and the far-sighted policy of the landlords that made such farm size possible. The Cromarty estate was divided, early in the nineteenth century, into seven 300-400 acre and seven 150-300 acre farms. Likewise the Cromarty field size is the largest of the Black Isle parishes, being in the range of 20-25 acres with 40-42 acre fields occurring frequently (Fig. 4).

In recent years, re-afforestation has changed the face of the Black Isle. The present pattern of land utilisation shows a marked extension of the woodland since the last published survey of 1932-34. In this work, the Forestry Commission have encountered many difficulties, not

Fig. 4. The Cromarty peninsula, the Black Isle: farm division and land utilisation in 1959. Farm boundaries are marked by a thickened line, and tillage crops are represented by their initial letter. O = oats; B = barley; T = turnip; W = wheat; P = potatoes.



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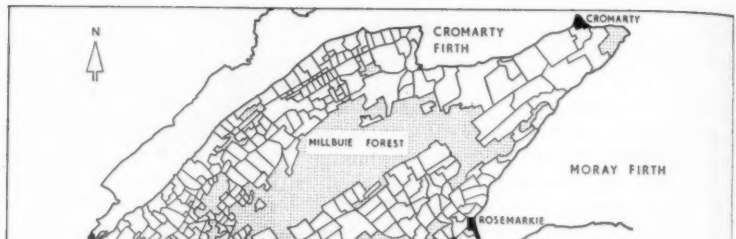

Fig. 5. The Black Isle : land-holding units in 1959.

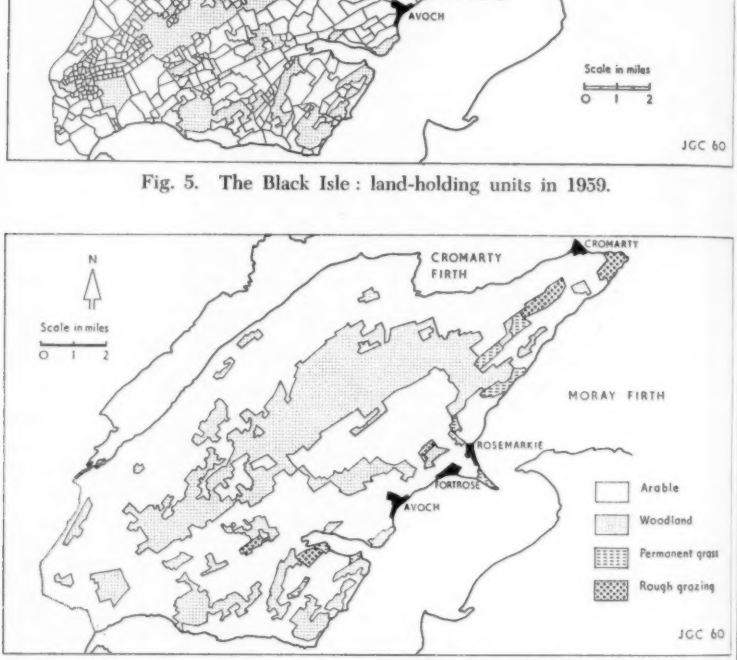

Fig. 6. The Black Isle : land utilisation in 1959.

least that of planting soils where drainage was impeded by an iron pan or an indurated horizon [9]. The success of some of the private plantations in the late-nineteenth century (e.g. Kilcoy in the eighteen-sixties) was the result of intensive artificial drainage, and the failure of many more was due to the neglect of it. When Government planting began in 1926, the areas planted had not had a tree crop for over a hundred years. In the period 1926-37, only the plantations on freely drained slopes such as the Kessock conglomerate hills, were successful. In the post-war period, most of the Millbuie common, parts of the Moine gneissic block, and plots on the west end of the peninsula, have been planted after ploughing more than 12 inches deep to break through the iron pan.

and draining-ditching. The soils are all acid, the nursery green-crops requiring much liming, and hence the Scots Pine is the most common tree. On Millbuie, it makes up 80 per cent, but this falls to 53 per cent at Kessock, where the Douglas Fir comprises 23 per cent. Most of the forests have between 5 and 10 per cent of either a species of spruce or larch. The sheltered situation of the Black Isle, and its low rainfall — 30 inches mean annual fall on the crest of Millbuie, and 23.8 inches at Fortrose — favour tree growth, provided measures are taken to improve the drainage and fertility of the soil.

The re-afforested areas are those which have never had an agricultural use other than rough grazing, and only on the margins of the Millbuie ridge, where over 600 acres have been gained from the farms, has agricultural land been planted in significant proportions. The 1959 land utilisation map (Fig. 6) shows how little rough grazing remains. This, and the small areas of permanent grass, are all situated within the farm units, and are confined to areas where slope is too great or the soil is too infertile for agricultural cultivation.

The rapid increase of woodland, in place of moorland, has reached the stage when further expansion must be at the expense of arable land. Most of the land unsuitable for tillage has been planted in woodland, and tree growth has been particularly successful in the most recent plantations. Forestry Commission efforts to gain arable land have met strong opposition from the farming community, who have lost already a considerable acreage of grazing land to the Commission. The position is now resolved, and it is likely that the distribution of the main types of land use will remain unchanged for many years (Table 3.).

Parish	Total acreage	Arable *(Per cent)*	Permanent grass and rough grazing *(Per cent)*	Woodland *(Per cent)*
Cromarty	8,018 acres	53.3	23.4	23.3
Rosemarkie	6,694 ,,	47.6	19.1	33.3
Resolis	12,472 ,,	50.0	13.9	36.1
Avoch	8,016 ,,	45.0	6.3	48.7
Knockbain	11,635 ,,	52.5	12.4	35.4
Killearnan	7,735 ,,	52.9	9.4	37.7
Black Isle	54,570 ,,	50.6	13.6	35.8

Table 3. Percentage land use in the Black Isle, 1959.

The arable land shown on the land utilisation map, (Fig. 6), includes some permanent grass and rough grazing within the farm units. Almost all the farms on the Black Isle are engaged in a mixed-farming economy. There are few specialists, but a small gardening enterprise near Cromarty finds its market in Inverness. The bulk of the crop production is for home consumption, for the feeding and fattening of stock. Beef cattle outnumber dairy herds by ten to one, and the cattle stocking is one beast to one-and-a-half acres of rotation grass. Sheep rearing is

equally important and the stocking is higher, being one to one acre of grass. Stock farming is traditional, and yet there have been serious problems of animal disease caused by trace-element deficiency in the soil.

Such is the character of the agricultural landscape of the Black Isle. The non-arable land has varied only slightly in geographical distribution during the last two centuries, but its use has altered with time, first as a source of turf fuel and as common grazing land, and most recently as plantation forest. In this change, as in arable improvement since 1800 the natural disadvantages of the soil cannot be ignored. The frequency with which the phrase 'sour and wet soil' appears on estate maps and in *Statistical Accounts* infers that a large measure of artificial treatment is necessary to maintain the fertility of the acid soils and to improve the imperfect land-drainage. These physical controls on land utilisation have been off-set by the favourable agricultural climate and the absence of unworkable slopes in the Black Isle. This contradictory physical background, and the particular marine environment [10], cannot supply the explanation of the local land-use pattern without acceptance of the influence of social factors involved in the land-tenure system. The farm land rented from estates has decreased in the last century, but is still more than half (57 per cent) of the agricultural acreage. Consequently the human factor of the landlords' initiative, in the division and use of the estate land, has been important in this area. The village communities have been employed in fishing, and lately tourist interests, so that it has been left to comparatively few individuals to shape the rural landscape. These men have been more closely connected with similar lowland areas in the south, in which mould the Black Isle land-use pattern has evolved. The resultant impression contrasts strongly with the peripheral Highlands, and uniformly stamps the peninsula with its geographical character.

The Black Isle is an area of physical and regional unity, man-managed for so long that there is no natural vegetation remaining. For this reason, it provides an interesting example of land utilisation that has been influenced by the physical environment, especially by soil which is the summation of its constituent factors, by the human element and the agricultural economy of the period.

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SOME ASPECTS OF GLACIAL DRAINAGE CHANNELS IN BRITAIN

PART II

J. B. SISSONS

In the following pages certain types of glacial drainage channels will be described and factors affecting their origins will be considered. It is not proposed to attempt a complete classification of channels nor to discuss all types of channel, since, owing to our present inadequate knowledge, this is not advisable or practicable. Rather is it intended to show that channel origins are far more complex than has often been assumed and that origins suggested in the literature often require re-examination.

Marginal and submarginal channels. Marginal channels have been frequently described as occurring in many parts of Britain by numerous authors; submarginal channels have rarely been mentioned. In contrast, Mannerfelt has stated that in the parts of Sweden he has studied submarginal channels are the commonest type [1]. The probable reason for this apparent discrepancy in the evidence from these two areas is that in Britain a marginal origin has been assigned to virtually all channels that run along, or at a small angle with, the contours of slopes. Yet while a channel so situated shows that glacier ice stood on its downslope side, thus preventing the waters from running freely downslope, is does not show that ice was not situated on its upslope side. In other words, such a channel might well have been formed by a stream flowing along the hillside in a tunnel beneath the ice. In many instances where a marginal origin has been claimed for a channel there seems to be no reason why this explanation should not apply.

In some instances a submarginal rather than a marginal origin is suggested by the gradients of channels, for they appear too steep to have been developed along an ice-margin. Where hillside channels of varying gradients occur in juxtaposition their relationships may show that, even if the more gently inclined ones are of marginal origin, the more steeply inclined ones certainly cannot be. Such relationships are illustrated in Figure 5, which shows a part of the complex system of channels, mostly less than twenty feet deep, situated on the southern side of Strath Allan, Perthshire (See Pl. 3). Some of the highest channels here have fairly gentle gradients of about 2 per cent and may be in part marginal features. Many of the lower channels, however, as can be seen in Figure 5, have much steeper gradients and must have been cut by meltwaters flowing obliquely downslope beneath the ice. This origin is indicated not only by the channel gradients but by the sudden changes in direction of many of the channels, which show that frequently the meltwaters flowed obliquely down the hillside beneath the ice for a short distance, then turned suddenly to flow straight downslope, only to resume their oblique descent again after a few tens of yards. Such patterns seem to reflect control of the submarginal drainage in part by structures in the ice. It may be noted, too, that some of the submarginal channels are

in places mere benches, *i.e.* one side of the channel is missing: thus the frequently made assumption that a one-sided channel is always a marginal feature is not valid [2].

Systems of submarginal and marginal channels are best developed on long, gentle or moderate slopes. This seems to be true not only in Britain (*e.g.* the systems shown in Figures 5 and 6 occur on such slopes) but also in parts of Scandinavia [3] and of Labrador [4]. Derbyshire [5] has pointed out that such channels are best developed on till-covered slopes in Labrador, and this appears to be often the case in Britain. It would seem that the steeper the slope the greater was the likelihood of meltwater streams finding their way downslope beneath the ice. In the case of marginal drainage it would be expected that, where the ice lay against a steep slope, the meltwaters would tend to erode the ice rather than the hillside. Hence marked channels are unlikely to have been formed on such slopes. Where till or other drift mantled slopes the chances of marginal drainage cutting into these slopes rather than into the ice were increased since channels could more easily become established in the unconsolidated material.

It is often difficult to prove that a channel was formed strictly marginally, rather than submarginally. One case where a marginal origin is often indicated is where channels alternate with kame terraces in aligned sequence. For example, such relationships exist in East Lothian south of Dunbar. In some instances, however, kame terraces were formed submarginally, as Holdar [6] has shown. In Figure 6 kame terrace fragments A, B, C and F and channel DE may indicate a marginal drainage resulting from the emergence at the ice-margin of the stream that built esker RSA. On the other hand, it is possible that all these features were formed beneath the ice, for it is conceivable that a depositing-stream flowing along a hillside beneath the ice might lay down its deposits in the form of a terrace. Such terraces would be the depositional counterpart of the subglacially formed one-sided channels referred to above.

Where gently inclined channels run approximately parallel with one another along slopes for considerable distances a marginal origin seems likely. That such characteristics are not in themselves proof of a marginal origin, however, can be shown by a consideration of some of the channels mapped in Figure 6. Channels GH, JK, LM and NO have gradients of about 2 per cent, are approximately parallel with one another, and are cut into a fairly gentle drift-covered slope. A marginal origin may therefore seem probable. However, between these channels cross-channels occur in places. For example, cross-channels at M, P and Q were cut by meltwaters flowing from LM to NO. The height relationships of these channels at their junctions with each other show that the cross-channels functioned successively from east to west. The last to operate, Q, cuts down nearly to the present floor-level of NO. This suggests that, by the time Q had been formed, NO had been excavated almost to its present depth. Thus at one and the same time meltwaters flowed in two parallel channels: LM (or part of it) and NO. A simple marginal explanation of the channels is therefore precluded. It also follows that NO was largely or entirely formed subglacially. Hence the possibility that the adjacent channels were also formed subglacially has

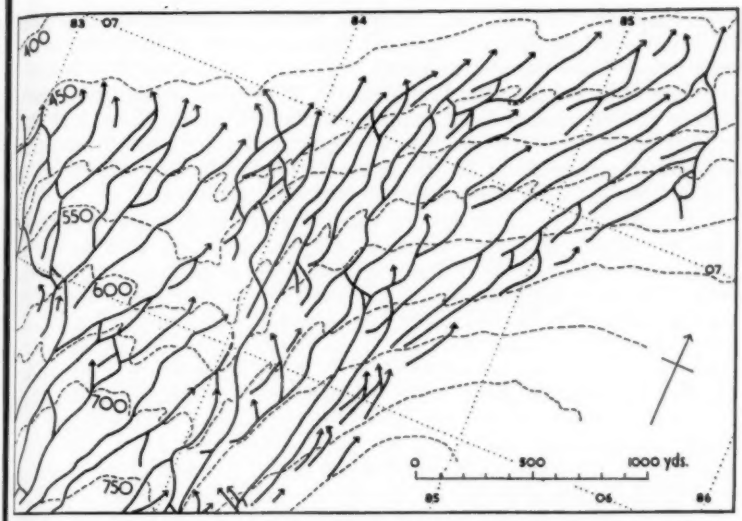

Fig. 5. Meltwater channels on the southern side of Strath Allan, Perthshire. Dotted lines are kilometre National Grid lines.

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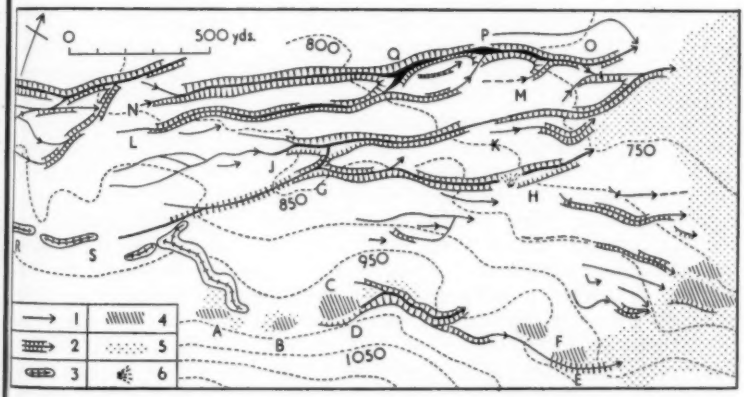

Fig. 6. Glacial drainage features at foot of northern slope of Tinto Hill, south Lanarkshire. 1. Very small meltwater channel; 2. Larger meltwater channel (no channel exceeds 25 ft. in depth); 3. Esker; 4. Kame terrace; 5. Fluvio-glacial sand and gravel, other than eskers and kame terraces; 6. Alluvial fan. Letters explained in text. *Crown Copyright reserved.*

to be considered. Evidence favouring this interpretation is provided by esker RSA. Since this esker climbs the hillside through some eighty feet and was formed subglacially, any marginal drainage that occured along the hillside in the vicinity of the esker, as the latter emerged through the downwasting ice, should have quickly breached the unconsolidated

esker deposits. No breaches occur in the esker, however. One must therefore conclude that no marginal streams existed in its vicinity. The meltwaters from the downwasting ice must have therefore escaped supraglacially, englacially or subglacially. If, as seems likely, these meltwaters flowed mainly subglacially, channels GH, JK, LM, NO and related channels may well have been excavated by them. The approximate parallelism of the channels might then be explained as having resulted from control by structures in the ice.

Descriptions of drainage associated with present-day temperate glaciers make it clear that a simple marginal drainage, such as has so often been assumed in Britain in interpreting meltwater channels, frequently does not exist. Russell, describing the Malaspina area, said that on the borders of the tributary glaciers important streams frequently occur, but where these streams "come down to the Malaspina, they flow into tunnels and are lost to view [7]". Von Engeln wrote: "All valley glaciers probably exhibit some development of marginal drainage features.... Such streams are, however, normally of small volume and short, disappearing under the ice before they can attain any great size.... [8]". Von Engeln also emphasised the importance of submarginal drainage in valley glaciers, and his remarks may well apply also to other glaciers margined by rising ground. He wrote: "Where a valley glacier has existed for a considerable period of time without experiencing any spasmodic disturbance of its mass, whether it is land-ending or tidal, nearly stagnant or in active motion, its lateral drainage will normally be submarginal [9]". Tarr, referring to the same area, stated that the "marginal channels are noted for their lack of continuity [10]". Sharp, describing the marginal streams of the Wolf Creek glaciers, Yukon Territory, said that "their length is usually not great, for they soon enter englacial channels [11]". These and many other authors have described the variable conditions associated with marginal drainage: for example, the creation of temporary small lakes that are suddenly drained beneath the ice, the sudden changes in stream courses conditioned by the availability of routes into and out of the ice, and the fact that the marginal streams at times flow on the ice itself. Von Engeln [12] mentioned a specific instance where a marginal channel appeared to have been initiated submarginally and subsequently exposed by retreat of the ice-margin. A further possible factor in the formation of some marginal channels has been recently discussed by Schytt [13]. He has suggested that lateral drainage channels on the north side of the Moltke Glacier, Greenland, were developed in relation to dirt-laden shear planes along the glacier margin, and shows how two, or even three, parallel streams may flow along and just within the margin of a glacier at the same time.

Another aspect of marginal channels that appears not to have been investigated in Britain is their possible relations to periods of active ice movement. Mannerfelt [14] emphasised the importance of submarginal and subglacial drainage during stagnation. Conversely, one might expect the absence or poor development of such drainage (or, at least, of evidence of it) and a strong development of marginal channels to characterise former periods of active ice movement. In this context Von Engeln's observations on the glaciers of the Yakutat Bay region are significant. He stated: ".... under certain conditions marginal streams

of great volume occupy such channels between the ice and the mountain side. The relations observed indicate that the typical occurrence of these large-volumed marginal streams is a phenomenon following upon the rapid advance of valley glaciers; and that they do not develop where normal conditions, dependant on long-continued, uniform climatic influences prevail [15]". If this evidence has wider application (and it has to be noted that Flint [16] found different evidence, but under different climatic conditions, in north-east Greenland) it might be possible to deduce from marginal channels periods of renewed glacial activity during deglaciation in areas such as Britain. Von Engeln's evidence also seems to carry with it the significant implication that marginal drainage should have been more common during the advance of glacier ice to its maximum extent than during periods of general deglaciation.

Subglacial chutes. This term was introduced by Mannerfelt [17] to apply to channels cut by streams plunging down slopes beneath the ice. Channels of this type are very numerous in many parts of Britain, but their origin has only occasionally been recognised [18]. Usually they have not been shown on published maps of channels. A few maps, however, show them clearly, especially some of the Geological Survey One-Inch sheets and some of the maps in the Geological Survey Memoirs [19], although their origin appears not to have been explained in these memoirs.

A simple type of subglacial chute occurs as the continuation of a marginal or submarginal channel (e.g. A Fig. 1, AB Fig. 9). One may follow the marginal or submarginal channel along the side of a hill to find that it suddenly turns sharply to plunge steeply down the hillside as a chute. In the case of a marginal channel the point at which the channel suddenly changes direction is the point at which the waters flowing along the ice-margin turned to plunge beneath the ice. In some instances the route followed by the meltwaters before they found a path down the slope is indicated by the continuation of the marginal (or submarginal) channel beyond the upper end of the chute.

Mannerfelt [20] related the formation of subglacial drainage channels and the supposedly regular spacing of marginal channels to the annual melting rhythm of the ice. He suggested that marginal drainage operated mainly in the early part of each melting season and that subglacial drainage became dominant in the later part of each melting season with the opening of the subglacial tunnels, an interpretation that seems to receive some support from Tarr's remarks on the Lucia Glacier, Alaska [21]. This annual concept has been criticised, however, by Holdar, who found an average spacing of over 20 metres between marginal channels in the part of the Swedish mountain chain he studied, a spacing far too large to be related to the annual ablation [22]. Schytt [23], as noted above, has suggested that the spacing of the marginal channels of the Moltke Glacier, Greenland, is controlled by dirt-laden shear planes. Presumably as a result of these criticisms, Mannerfelt [24] has recently expressed doubts concerning his annual interpretation of certain Swedish meltwater channels.

In the areas studied by the writer in Britain channel relationships often seem to imply that subglacial routes were available from the very beginning of the melting season. Figure 7 provides a simple illustration.

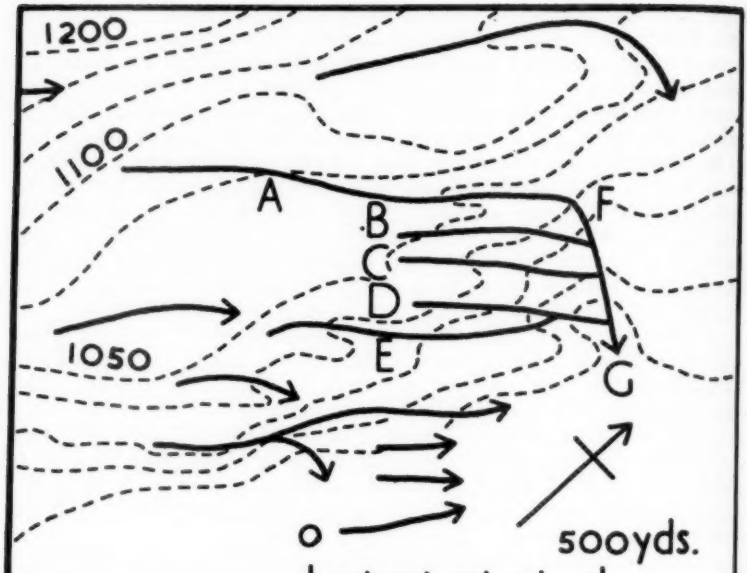

Fig. 7. Some meltwater channels to west of Eddleston valley, Peeblesshire, about 2 miles WNW of Waterheads. Letters explained in text.

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Here the channels A to E all end in subglacial chute FG and there is no trace of meltwater erosion beyond the chute. Whether or not the five channels A to E are related to the annual ablation of the ice, the fact that E lies some 50 feet lower than A indicates that more than one melting season was involved in their formation. The chute FG carried their waters throughout this period and must have functioned therefore from the beginning of each melting season.

Many subglacial chutes are unrelated to preglacial (or interglacial) stream courses (although they have quite frequently provided ready-made valleys for small misfit postglacial streams). Other chutes, however, developed along pre-existing valley floors. In such instances one may sometimes follow marginal or submarginal channels along a hillside to find that they terminate along the line of a stream descending the slope. The stream itself may be found to occupy a steep-sided trench, whose origin as a subglacial channel can be deduced from its continuity with the marginal or submarginal channels. One may presume that the development of subglacial channels along such valley floors was facilitated by the relief and by the relatively warm waters of these streams as they flowed down the ice-free parts of their valleys towards the ice-margin. Liestøl [25] mentioned the importance of streams flowing down valley-sides in keeping open a large subglacial drainage system and measured tempartures of 3 to 12° C. (c. 37-54° F.) in August,

1949, in brooks flowing down into a glacier in Norway. Von Engeln [26] also stressed the importance of the warm land-drainage and found its temperature to be around 44° F. (6.7° C.) in late July and early August in the valley of the Galiano Glacier, Alaska. It is interesting to note, too, that von Engeln described, on the north side of the Hidden Glacier, Alaska, drainage apparently identical with that described above. He wrote: "On the lower side of a rock spur there was commonly an emergence of a marginal stream from an ice cave at the shelving ice edge, and this marginal stream then continued along the ice and rock contact until it became confluent with the major stream of the valley embayment (i.e. side valley) drainage. At the point of confluence both the valley drainage and the marginal drainage disappeared under the ice through a low ice cave [27]".

In addition to occurring singly, as described above, subglacial chutes frequently occur in groups, sometimes as parts of quite complex channel systems. A common location for groups of chutes is where the ice during its downwasting extended as tongues up valleys owing to the emergence above the ice surface of the intervening spurs. In such situations the marginal and submarginal drainage, instead of following the ice-margin into each re-entrant, frequently plunged beneath the ice and cut subglacial chutes. Presumably the development of chutes in such locations was facilitated by the fact that the ice tongues extending up the valleys would tend to stagnate more readily than the main ice-mass, particularly where, as was frequently the case, such valleys lay transversely to the main direction of ice movement. An example of such chutes, cut into one flank of a broad embayment in Midlothian, is shown in Figure 8. Although some of these channels are at present occupied by streams they are not of postglacial origin. This is indicated by their relations to each other and by the fact that some of them are continuous with streamless channels that run along the generalised contours of the embayment. Some of the chutes lead into the valley of the South Esk, which stream occupies a steep-sided trench (now partly infilled in places by later-formed river terraces and alluvium) that is itself probably in part a subglacial channel that carried the waters of numerous tributary channels beneath the ice.

In some localities chutes occur in large numbers with only a limited development of marginal and submarginal drainage. An example is shown in Figure 9. That these valleys are not postglacial gullies is shown by (i) their relation in a few instances to marginal and submarginal channels, (ii) the oblique descent of some of the channels, (iii) the abrupt beginnings and endings of some channels, (iv) the fact that many of the channels stop part way down the steep slope into which they have been cut, (v) the absence from the lower ends of the channels of alluvial fans, (vi) the absence of streams from the channels, including some that exceed 50 feet in depth, there being only one exception to this (C, Figure 9, which is utilised by a stream significantly named Dry Burn).

Numerous short subglacial chutes are shown in Figure 5 and frequently occur as continuations of the short, steeply inclined, downslope segments of the submarginal channels. They represent the routes by which these channels were abandoned, this abandonment usually

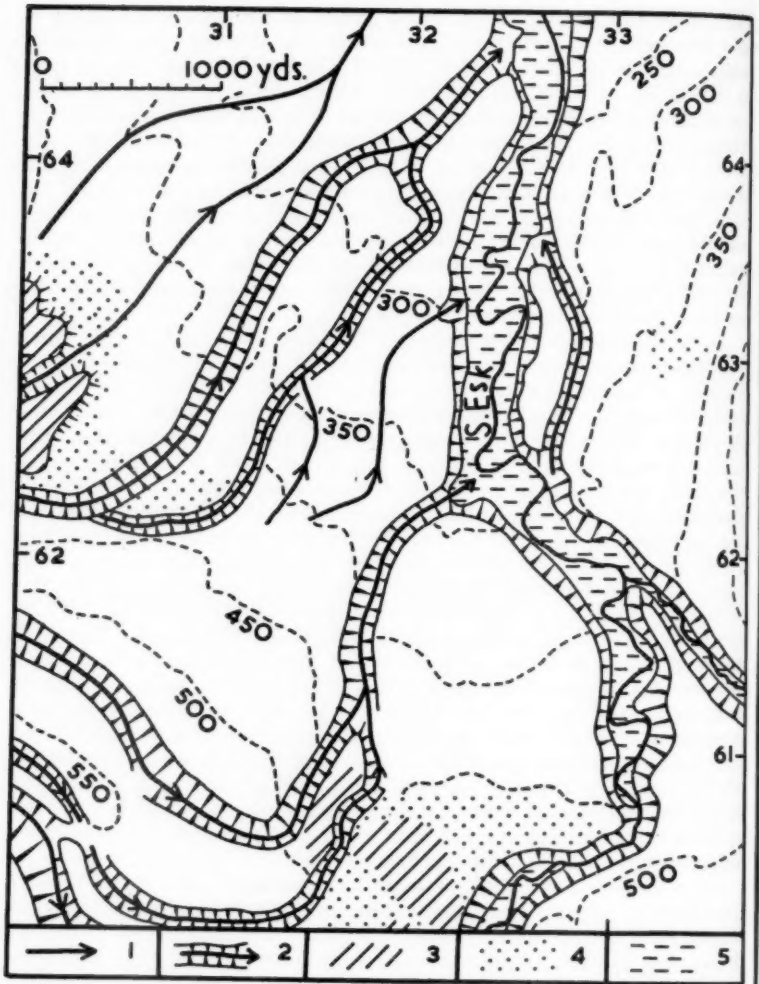

Fig. 8. Glacial drainage features in eastern Midlothian, near Newtongrange. 1. Small meltwater channel; 2. Larger meltwater channel; 3. Kame terrace; 4. Fluvio-glacial sand and gravel other than kame terraces; 5. River terraces and alluvium. National Grid kilometre lines indicated round margin of map.

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having occurred successively from east to west. One of the largest subglacial chutes occurs in the extreme east and carried the waters of five channels that join it. In the north-central part of the map complex relationships between the submarginal channels and subglacial chutes are shown. In general the map illustrates the attempts of the melt-

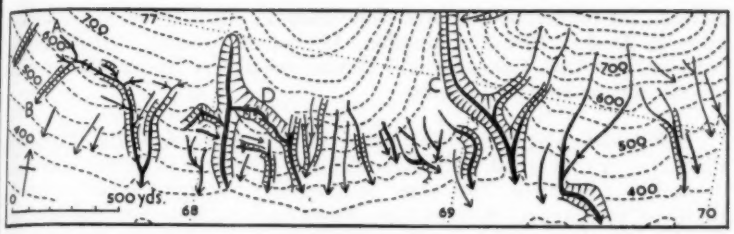


Fig. 9. Meltwater channels (mostly subglacial chutes) some three miles north-east of Fettercairn, Kincardineshire. Width of arrows proportional to width of channel floors. Larger channels shown by hachures. Letters explained in text. Dotted lines are kilometre National Grid lines. *Crown Copyright reserved.*

waters to find routes straight down the ground slope beneath the ice and the partial success of the ice in preventing this, resulting in the two dominant directions of channels shown on the map. It will be noted, however, that some channels follow intermediate directions and it is difficult to decide whether they should be classed as subglacial chutes or submarginal channels. This serves to illustrate the fact that these two types of channels grade into each other.

The effect of the relief and the ice in controlling the development of streams in the submarginal zone is also illustrated in Figure 10. The origins of most of these channels are very similar to those of the channels shown in Figure 5, even though the pattern appears at first quite different. The channels shown in Figure 10 are cut in bedrock and are mostly less than twenty feet deep. The pattern can be resolved into submarginal channels descending obliquely, but often quite rapidly, down the slopes of the embayment, and subglacial chutes going straight down the slopes, the whole system being essentially convergent owing to the pre-existing ground slopes.

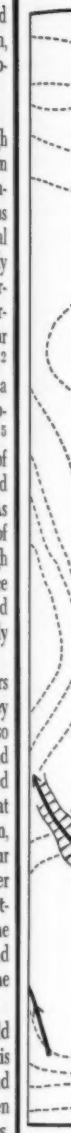
One other aspect of subglacial chutes that should be mentioned is their possible significance in the draining of ice-dammed lakes. This aspect of chutes has apparently not yet been considered in Britain, although A. G. Macgregor [28] mentioned the existence of numerous dry gorges (apparently subglacial chutes) associated with the draining of an ice-dammed lake in Ayrshire, and Bremner [29] referred to an ice-dammed lake in the Findhorn valley that was drained both along the ice edge and by subglacial channels. In Sweden the idea of subglacial drainage of lakes has been developed by Gillberg [30] in his paper on the deglaciation of a part of the Swedish highlands. He has deduced the former existence of numerous marginal lakes along the mountain slopes during the downwasting of the ice-sheet. These were not large lakes, however, such as have been frequently described as formerly existing in Britain, but were mostly narrow marginal strips of water. Many of the lakes were developed on the flanks of emerging nunataks and must therefore have been drained via the ice itself. Gillberg states that the outlets of some of the lakes were subaerial but that most were subglacial, sometimes by inclined submarginal routes, at other times by subglacial chutes, the escaping waters subsequently becoming englacial. Such an interpretation is consistent with the evidence from modern

glaciers, for numerous accounts show that the drainage of ice-dammed lakes in Alaska, British Columbia, Greenland, Iceland, Spitsbergen, Norway, the Alps, Caucasus and Himalayas is very frequently by subglacial and/or englacial routes.

Subglacially-engorged eskers and some related deposits. Although this paper is concerned with channels, it is necessary to mention certain depositional features. The term "subglacially-engorged esker" was introduced by Mannerfelt [31] to apply to eskers built by subglacial streams flowing into the ice. They are the depositional counterparts of subglacial chutes. In Britain eskers have been usually explained as formed only by streams flowing out of the ice, but occasionally the origin put forward by Mannerfelt has been suggested. For example, this interpretation seems to have been favoured for some esker-like features near Oswestry by the Geological Survey officers who mapped that region [32] and by Bailey [33] for two eskers in Ayrshire. Bremner [34] mentioned a "kame" in the Aberdeen area that might have been formed in a subglacial tunnel by a stream flowing into the ice, while Pallister [35] described mounds on the lower slopes and bottoms of valleys in part of Dumfriesshire and mentioned the possibility of their having been formed by land streams washing gravels down crevasses into stagnant ice. As long ago as 1898 Garwood provided a very interesting description of how, in Spitsbergen, the draining of a small ice-dammed lake through the ice had resulted in a gravelly deposit along the floor of an ice tunnel at right-angles to the direction of the glacier flow and suggested that "we have here an instance of one possible origin of the gravelly ridges known in our country as kames and eskers [36]".

In parts of south-east Scotland, at least, subglacially-engorged eskers are fairly common, and the writer has noted some fifty or more. They are usually slightly sinuous ridges, often no more than twenty feet or so high, descending slopes and sometimes extending onto flatter ground at the base of the slopes. Many of them are no more than a few hundred yards long, although a few are much longer. The till mantle that Mannerfelt described as occurring on Swedish examples is not common, although angular and subangular cobbles and boulders sometimes occur on the eskers. Some of the eskers have no obvious relation to other glacial drainage features. A few of the eskers mapped continue meltwater channels and were clearly deposited by the streams that cut the channels. Some others lead away from large accumulations of sand and gravel, sometimes beginning at approximately the same level as the surface of an adjacent kame terrace.

While the features mentioned in the preceding paragraph would probably be accepted by most geomorphologists as eskers on the basis of their form, there exist far more numerous moundy deposits of sand and gravel that would usually be described as kames, yet which often appear to have a fairly similar origin to the subglacially-engorged eskers. Frequently such kames are closely associated with meltwater channels. For example, along the lower slopes of the western side of the north-south Eddleston valley, Peeblesshire, a series of kames extends for some four to five miles and varies in width between half a mile and nearly a mile. On the valley side immediately above the kames is a complex



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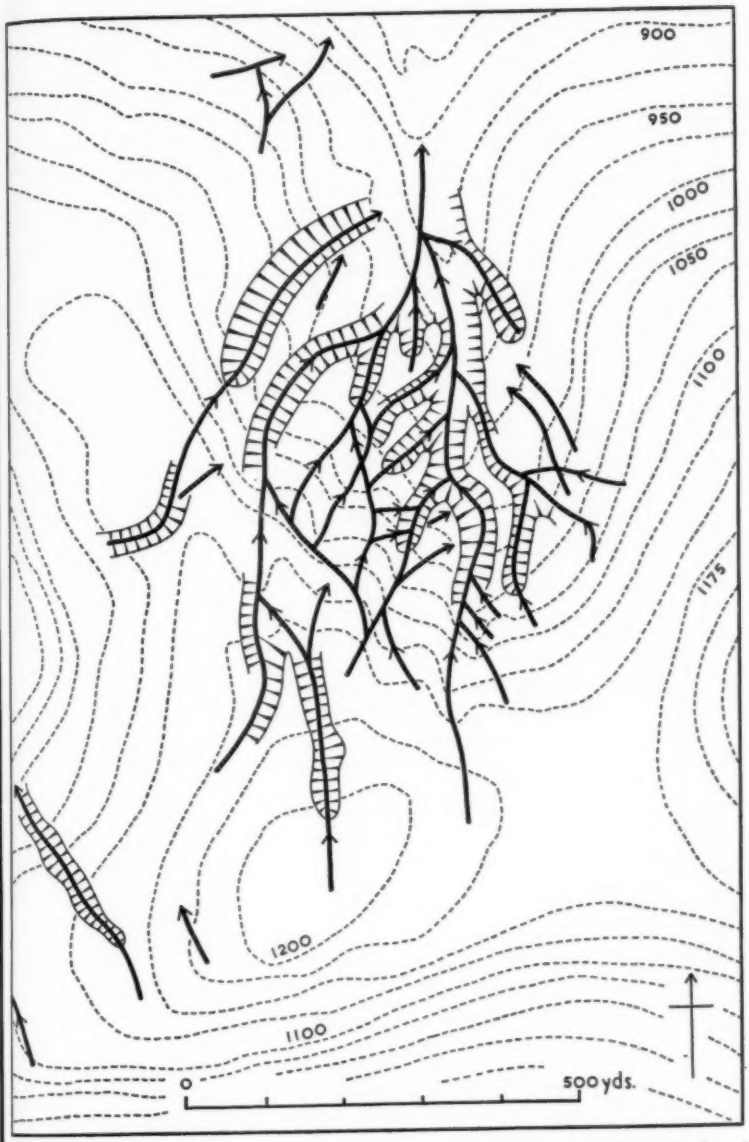

Fig. 10. Meltwater channels on part of an east-west spur on eastern side of Eddleston valley, Peeblesshire. Hachures indicate channels deeper than about 10 feet.

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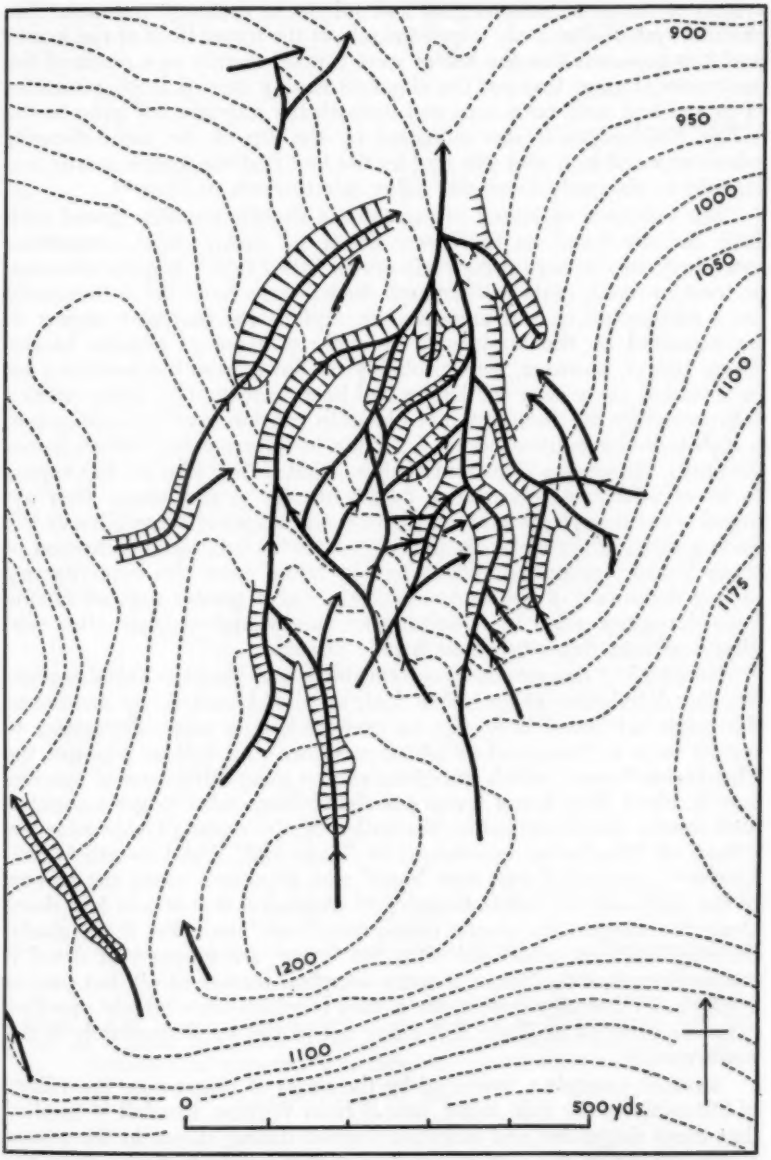

Fig. 10. Meltwater channels on part of an east-west spur on eastern side of Eddleston valley, Peeblesshire. Hachures indicate channels deeper than about 10 feet.

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system of marginal, submarginal and subglacial drainage channels. The channel system dies away approximately at the upper limit of the kames and it is apparent that the kames were formed mainly as a result of the meltwater streams that cut the channels having carried large quantities of gravel and sand onto, into and beneath the stagnant ice lying in the valley. This origin is also indicated by the dip of the kame deposits where exposed in gravel pits and by the fact that the kames mostly run straight or obliquely down the valley side towards its floor [37].

The existence of kames (or spreads of slightly moundy gravel with little definite form) on the lower slopes of valley sides, sometimes extending onto or even completely across valley floors, is quite common, at least in many parts of Scotland. Such kames have not infrequently been interpreted as end moraines, an explanation that may appear to be indicated by the occurrence on some of them of angular blocks. These blocks, however, were probably let down from the overlying ice as it wasted away after the kames had been formed. This interpretation is favoured by the distribution of blocks in relation to many such kames, a distribution remarked on by J. Geikie in referring to Scottish kames generally. He wrote : "It is remarkable.. that if they (the blocks) appear to be of infrequent occurrence in the interior of the kames, they are found often enough dotted over the tops and slopes of these hillocks [38]". Such a distribution of blocks is consistent with subglacial formation of these kames, occasional blocks having fallen from the overlying ice during deposition of the kame materials, and a greater number having been deposited when the overlying ice finally melted away after subglacial stream deposition had locally ceased.

Pallister's [39] description of certain ridges and knolls in Dumfriesshire fits the description given above and, as already noted, he mentioned the origin advanced here. Yet he preferred, after some discussion, to regard them as "marginal or lateral moraines". As another example the Thankerton 'kame', which has given rise to some difference of opinion, may be cited. This 'kame' forms a series of steep-sided ridges associated with kettles extending across the valley of the middle Clyde near the village of Thankerton, north-east of Tinto Hill. Charlesworth [40] and Linton [41] concluded that this 'kame' was deposited along the margin of the Highland ice, while Gregory [42] concluded that it was laid down along the margin of a glacier descending from Tinto. Yet if the glacial drainage features associated with the 'kame' are mapped in detail it can be seen that the 'kame' is not a marginal feature at all, but part of a subglacial drainage system, the waters of which were largely provided from the nunatak of Tinto Hill rising out of the ice immediately to the south-west [43].

Another example is provided by the series of ridges near the village of Glaisdale in the Esk valley, inland from Whitby. Kendall [44] implied that these ridges are end moraines formed during stages in the retreat of the ice down the Esk valley. He stated, however, that, unlike the Lealholm moraine further west, these ridges are composed of sand and gravel. The ridges are shown in Figure 11, as also are the well-marked terraces of sand and gravel found in the same area. The terrace deposits extending down the valley of Stonegate Beck between altitudes of 550 and 600 feet were laid down by the meltwaters that had crossed

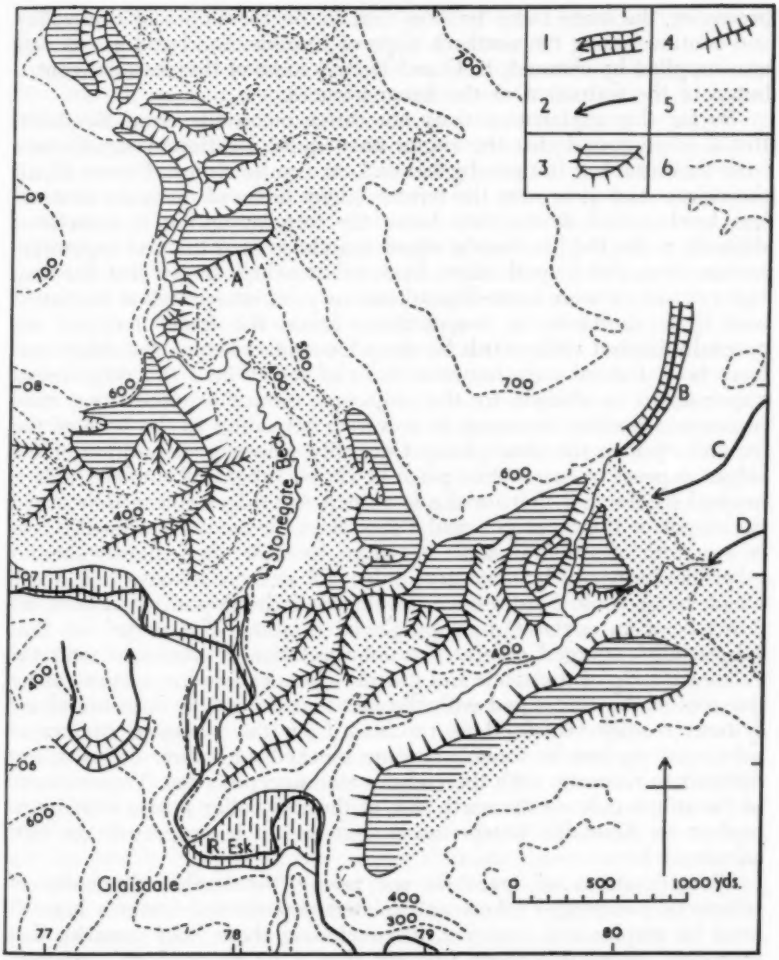

Fig. 11. Glacial drainage features in the Esk and Stonegate valleys near Glaisdale, north-east Yorkshire. 1. Large meltwater channel; 2. Small meltwater channel; 3. Fluvio-glacial terrace; 4. Subglacially-engorged esker; 5. Fluvio-glacial sand and gravel not mapped as terraces or eskers; 6. Contour. Letters explained in text. National Grid kilometre lines indicated round margin of map.

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the northern watershed of the Esk valley by the deep Tranmire Slack and related meltwater channels. As far down the Stonegate valley as point A, Figure 11, where a major ice-contact slope runs across the valley, the terrace deposits appear originally to have extended completely across the valley. Below this point deposition took place on either side of the mass of dead ice lying in the Stonegate valley,

producing the large kame terraces that lie on the slopes of this valley and continue along the northern slope of Eskdale. Sand and gravel was also supplied by channels B, C and D, and some of this material contributed to the formation of the kame terraces.

So far this explanation does not differ materially from Kendall's. But it is suggested that the ridges have quite a different significance from that attached to them by Kendall. As can be seen in Figure 11, all the ridges start at or near the terrace edges. Some of them are more or less level-crested where they leave the terraces and it is sometimes difficult in the field to decide where exactly to map the line separating terrace from flat-topped ridge. Such relationships imply that the two types of feature were formed simultaneously, an interpretation consistent with their similarity of composition. Since the kame terraces are generally limited valleywards by steep ice-contact slopes, the ridges can have been formed only between walls of ice. Where the ridge crests approximate in altitude to the adjacent terrace surfaces one may presume deposition occurred in crevasses extending to the base of the ice and open to the atmosphere. Generally, however, deposition of the ridges appears to have taken place in closed subglacial tunnels. This is implied by the fact that for the most part the ridges run rapidly down the slopes of the Stonegate and Esk valleys, descending some 200 feet in a quarter of a mile in some instances, by their often slightly sinuous esker-like form, and by their steep sides (20° or more in many instances), which latter could hardly have developed if the deposits had been let down from an englacial or supraglacial position. The ridges are thus subglacially-engorged eskers. This interpretation is consistent with the valleyward dip of the sands and gravels where exposed in sections along the axes of the ridges and with the fact that the ridges form branching systems readily visualised as resulting from the changing courses of subglacial streams as tunnels became blocked with their deposits, but difficult to reconcile with the end-moraine interpretation. The existence of the ridges only on the north side of the Esk valley is also difficult to explain on Kendall's interpretation but is to be expected on that advanced here.

Considerations of space do not permit the further discussion of subglacially-engorged eskers and related depositional features here. It must be emphasised, however, in concluding these brief remarks, that wherever practicable these features should be mapped as accurately as the channels. In favourable localities such mapping may reveal the pattern of glacier stream-flow in considerable detail and may provide the missing links between channels that have been frequently provided in the past by postulating lakes.

In-and-out channels. These channels formed one of the four types recognised by Kendall and he described them as crescentic valleys excavated in the face of a hill. He stated that they were formed "by water flowing round a projecting lobe of ice [45]", an interpretation accepted by Smith [46] and Derbyshire [47]. It is difficult, however, to envisage the existence of such lobes of ice, for the ice-margin normally conforms approximately with the contours of a slope. The fact that in-and-out channels resemble meanders suggests that they have been formed, at least in some instances, by meandering supraglacial or,

perhaps, englacial streams that cut down through the ice into the ground beneath, an explanation mentioned by Common [48].

The meandering habit of glacial streams, especially supraglacial ones, has been frequently mentioned or illustrated [49]. The origin favoured here for in-and-out channels has been stated by Sharp to apply to such channels situated on the side of a valley at present occupied by a glacier in Yukon Territory, for, referring to these channels he wrote: they "are clearly cutoff loops of entrenched meanders left hanging at both ends [50]". It should perhaps be added that the suggestion that supraglacial drainage may have, through its incision, produced channels is not inconsistent with the widespread evidence of subglacial drainage already discussed. Not only has one to take into account the fact that the relative importance of supraglacial and subglacial drainage may have varied during deglaciation in relation to the activity of the ice, but also that supraglacial and subglacial streams have often been described from immediately adjacent localities on modern glaciers. Furthermore, in some instances the development of supraglacial streams may have been favoured by a cover of fluvial deposits or moraine on the ice.

Other superimposed channels. If in-and-out channels may be formed by superimposition of streams from the ice, it is reasonable to expect that other channels too would show meandering courses. This is, in fact, often the case *(e.g.* Midlothian, East Lothian, Cleveland, Rossendale, etc.). In some instances the form of meandering channels indicates that the meanders developed during their incision into the rock (or drift) and it is unnecessary to postulate superimposition from the ice. Frequently, however, meanders are intrenched, not ingrown. Like in-and-out channels, such meandering channels are often found on slopes where the form of the ground would not permit meandering streams to develop marginally or extra-marginally. In such instances it is often difficult to avoid the conclusion that the meanders were developed supraglacially (or, perhaps, englacially) and then incised into the ground beneath the ice. This was mentioned by Hoppe [51] as a possible explanation of some Swedish channels that had occasional meanders. This explanation does not necessarily apply to all meandering channels, however. For example, Harrison and Thackeray [52] have presented evidence to show that the winding course of Newtondale in the North York Moors is related to joint planes.

Another way in which superimposed (not necessarily meandering) channels might develop was suggested by Lamplugh in the discussion of a paper on Spitsbergen by Garwood in 1899. Lamplugh asked "whether the Author had observed any instance where the streams flowing on the ice-sheets had intersected emerging ridges of solid rock [53]". In reply Garwood said he was unable to cite examples but agreed that meltwater channels might be formed in this way. This interpretation appears not to have been applied to channels cut across spurs in Britain until recently developed by Price [54] as a possible explanation of some of the channels of the upper Tweed valley. These channels cut indiscriminately across spur crests and then descend part way down the slope beyond. Price suggests that as the ice thinned the supraglacial and englacial streams became superimposed on the spur crests beneath. This drainage was thus disrupted and became subglacial (as

indicated by the channels) on the further side of each spur.

Open ice-walled channels. The term "ice-walled channel" was used by Gravenor and Kupsch [55] to include channels formed in open trenches in the ice as well as in closed tunnels. The former will be referred to here as "open ice-walled channels". So far as the writer is aware the formation of channels in open trenches has not been suggested in Britain, although the formation of certain 'kames' in such situations has [56]. Such an origin for some kames is consistent with Russell's evidence from the Malaspina Glacier. He described [57] how the Kame River emerged from a tunnel in the ice some three miles back from the border of the glacier to flow in an open ice-walled channel, the first half-mile of which was a narrow canyon with walls of dirty ice fifty or more feet high. The river was depositing large quantities of sand and gravel, partly on ice, and one may presume that, with favourable conditions, a linear kame-belt at right angles to the former glacier margin would survive after the ice wasted away. Another example of an open ice-walled channel was described by Roberts [58] in Iceland, where he found a shallow sixty-foot wide river flowing for several hundred yards between precipitous walls of dirty ice eighty to a hundred feet high.

Open ice-walled streams might develop either through collapse of the roofs of subglacial tunnels or through supraglacial streams cutting down through the ice (as was suggested above for the streams that cut some meandering channels). Russell's evidence from the Malaspina area indicates the formation of open ice-walled channels by collapse of subglacial tunnels, and this origin is envisaged by Gravenor and Kupsch [59] for some of the channels developed in association with a former ice-sheet in western Canada. The present writer has also suggested this origin for some of the huge channels formed by Great Lakes waters flowing through the Syracuse area in central New York [60]. The channels described by Gravenor and Kupsch are considered by these authors to have been cut partly in open trenches and partly in closed tunnels and in places they are related to esker systems. These channels form a complex pattern of parallel and intersecting elements. In one region two sets of channels occur at right angles, but the two sets were not everywhere used at the same time. These channels in western Canada in many respects resemble the Rinnentäler of Germany and the tunnel-dale of Denmark, where formation in closed tunnels is favoured, although Woldstedt [61] has suggested that erosion by the ice itself may have initiated the formation of some channels. The possibility that some channels in Britain have been formed by open ice-walled streams has therefore to be borne in mind.

Up-and-down channels. Many glacial drainage channels have up-and-down long profiles. Frequently a profile of this type has been obviously produced by accumulation of material on the channel floor. One of the commonest causes of this is the formation of alluvial fans by streams entering channels from their sides. Such fans were described from East Lothian by Kendall and Bailey [62] and referred to as "corroms". Some other channels possess up-and-down profiles owing to the accumulation of peat and/or mass-movement from their sides. There remains, however, a very significant number of other channels whose up-and-down profiles are due only partly or not at all to

deposition. At least six explanations have been put forward in the literature to account for such channels. These are as follows: (i) "unequal volumes of meltwater flowing in opposite directions more or less contemporaneously [63]"; (ii) postglacial stream erosion [64]; (iii) erosion of a channel whose upstream part is in drift and downstream part in rock, resulting in an uphill long profile in the more easily eroded drift [65]; (iv) erosion of a channel across a col previously lowered by a "preglacial" stream working backwards by headward erosion, resulting in the floor of the "preglacial" valley forming the uphill part of the profile [66]; (v) reversal of meltwater flow [67]; (vi) subglacial erosion by water flowing under hydrostatic pressure [68].

The first four explanations need be considered only briefly. The first one seems rather improbable and can hardly account for channels that are continuous well-marked features throughout their lengths. The second seems equally inapplicable in most instances, for postglacial streams are often absent or of small dimensions in the channels under consideration. Certainly in the example cited by Eckford [69] (Windy Gowl channel, Peeblesshire, Nat. Grid Ref. 36/1454) the half-mile uphill part of the channel could not have been excavated by the present tiny stream that occupies it: this stream has, in fact, cut a small notch a few tens of yards long into the floor of the uphill part of the channel. The third explanation applies to a particular case and cannot account for the numerous up-and-down channels where different geological conditions obtain. The fourth, although put forward by Twidale [70] as an explanation of up-and-down channel profiles, and hence listed above, is not really such. The uphill slope is simply the floor of a preglacial valley and the floor of the channel proper slopes in the same direction throughout its length. Such channels were long ago described by Kendall and Bailey [71].

The fifth explanation—reversal of meltwater flow through channels—has been by far the most commonly suggested. It was put forward originally by Kendall in 1902 [72]. In the following year he repeated the explanation, with some elaboration, apparently as a result of criticisms made by members of the Yorkshire Geological Society [73]. Subsequently, however, he appears to have become uncertain about this interpretation, for Elgee quotes a letter from Kendall on the problem of up-and-down channels as follows: "Experience gained in the last two years has made me suspicious of cases of apparent flow in opposite directions through the same channel. It is easier to assume that a transverse watershed or 'corrom' has been produced by inflow of a lateral stream, or by some similar means [74]". Much more recently Peel has discussed the reversal of drainage idea and has said that it suffers from the disadvantage "that it requires special conditions unlikely often to be fulfilled [75]".

The reversal of flow concept is certainly difficult to apply if one attempts to explain channels as lake overflows associated with an impenetrable ice-barrier, but these difficulties may disappear when the importance of drainage into the ice is recognised. For example, in the small area shown in Figure 9 the large number of subglacial chutes points to abundant drainage down the hillside beneath the ice. The mutual relations of some of the chutes show that they did not all

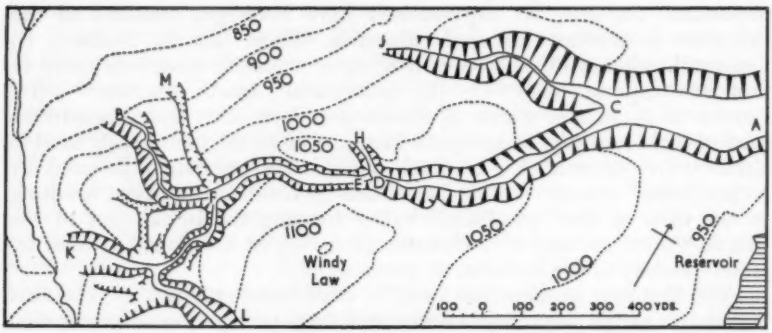

Fig. 12. An up-and-down channel (ADB and related channels on Lammermuir scarp some 4 to 5 miles SW of Gifford, East Lothion. Letters explained in text.
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function contemporaneously, and one can imagine how, with the blockage of one subglacial tunnel an adjacent one might have tapped the marginal or submarginal drainage, resulting in local reversal of this drainage and an up-and-down profile. Four up-and-down profiles do occur in the area, and at least one of them (D, Fig. 9) is very difficult to explain by any other hypothesis than reversal, for from the highest point on its floor the channel descends very steeply in both directions into a subglacial chute.

In addition to very localised reversal of flow such as that just cited, an up-and-down profile can be developed as a result of reversal of drainage on a larger scale. The example shown in Figure 12 was described by Kendall and Bailey [76]. The floor of this up-and-down channel (ADB, Fig. 12) lies at about 920 feet at its eastern end, 1,040 feet at its highest point (E) and 900 feet at its western end. Rock outcrops are frequent along the channel sides and exclude the possibility that the deposits that occupy the channel floor in places affect significantly the very marked up-and-down profile. Further up the same spur channel LK begins in a pre-existing col and descends steeply westwards, while adjacent minor channels slope westwards also. This implies that meltwaters first flowed westwards across the spur. The final stage of this westward flow is represented by EGB and EFM, the downslope parts of these two channels being excellent examples of subglacial chutes. The section DA and its tributary JC, as well as other channels and depositional evidence to the north, all indicate eastward flow. The up-and-down channel ADB is thus a composite channel, DB having been formed first and DA (or the greater part of it) later. The eastward-flowing waters that cut DA entered it via HD, which channel starts abruptly at H, indicating it was cut by a stream flowing out of (or less probably, off the surface of) the ice.

That this particular instance of reversal is not due to the fortuitous local development of escape routes into the ice but has a wider significance is strongly suggested by the fact that along the steep Lammermuir scarp for some fifteen miles to the north-east a great series of marginal and submarginal channels and kame terraces occurs, whereas

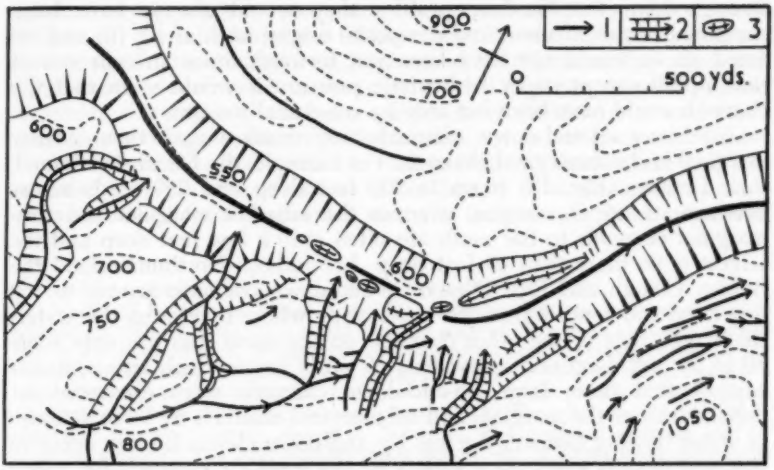

Fig. 13. The western part of the Deuchrie channel, some 5 miles SW of Dunbar, East Lothian. 1. Small channel; 2. Larger channel; 3. Esker. The floor of the Deuchrie channel rises eastwards as far as the small cross-line shown on the thickline marking the centre of the channel floor. *Crown Copyright reserved.*

to the south-west for some fifteen miles not a single feature of this type is present, there being instead a few subglacially-engorged eskers and possibly one or two subglacial channels. This contrast appears to be the result of the presence of two ice-sheets. To the north-east of channel ADB the presence of Highland ice, with a slight surface-slope towards the Lammermuirs, favoured marginal and submarginal drainage along the scarp face. To the south-west of the channel the Southern Upland ice-sheet covered the scarp and adjacent lower ground and its slope was slightly away from the scarp. The reversal of flow is probably related to differing rates of wastage of the two ice-sheets, the full significance of which has yet to be worked out.

Although reversal of flow can explain some up-and-down channels there are many others where it appears an unsatisfactory explanation. For example, up-and-down channels, sometimes of large dimensions, frequently occur as links in extensive glacial drainage-systems where all the other channels and related deposits point to glacial drainage in one general direction. It seems highly improbable that reversal of flow should have taken place in such areas, leaving as its only evidence the up-and-down channels themselves. In such instances the only adequate explanation seems to be erosion by subglacial waters flowing under hydrostatic pressure, an explanation that has been applied on the Continent, particularly to the tunneldale and Rinnentäler, which often have uphill profiles in places. Certain difficulties that may be encountered by this hypothesis have been mentioned by Peel [77] and have been discussed elsewhere [78]. Three points only will be mentioned here.

(i) Many channels with up-and-down erosional long-profiles are continuous features throughout their lengths, strongly suggesting that they were formed by streams of meltwater flowing in a single direction

through them. But for their profiles they would always have been explained in this manner, and composite origins such as (i), (ii) and (v) listed above would not have been put forward. Since streams cannot flow uphill except under hydrostatic pressure it would seem that the channels could have been cut only by subglacial streams.

(ii) Many up-and-down channels are much larger than nearby marginal and submarginal channels. For example, the Deuchrie channel, East Lothian (Fig. 13) is up to 200 feet deep and 250 yards across between its upper margins, whereas the adjacent marginal and submarginal channels to the south are often only a few feet deep and the largest is no more than 40 feet deep. In southern Northumberland the Beldon Cleugh and East Dipton up-and-down channels are up to 150 feet deep and some 200 to 300 yards wide where they cross the watersheds, yet most of the other channels on the same spur are only some 10 to 30 feet deep and a few tens of yards across. Such size contrasts suggest that these large up-and-down channels were excavated independently of the marginal and submarginal channels by large volumes of water flowing beneath the ice. Up-and-down channels often occur in cols and in such cases are a variant on the large col channels for which a subglacial origin was suggested in Part I of this paper.

(iii) Some up-and-down channels are so related to other channels and/or fluvio-glacial deposits as strongly to suggest a subglacial origin. The Deuchrie channel again serves as an example. As can be seen in Figure 13, the southern side of this channel is cut into by a number of smaller channels. These channels are subglacial chutes related to the marginal and submarginal channels further up the hillside. An esker lies on the floor of the Deuchrie channel, and its subglacial origin is proved by an exposure showing some two feet of ablation moraine containing angular blocks up to two feet across lying on top of the rounded, stream-deposited gravels of the esker proper. The Deuchrie channel must have been excavated therefore before the esker and subglacial chutes were cut. Hence it would seem that it also was excavated subglacially. The only alternative is to assume it was cut subaerially before the final deglaciation. It may well be that the channel was partly excavated prior to the final deglaciation, but this can hardly be the whole explanation, for the freshness of the channel form points to considerable erosion during the final deglaciation. Furthermore, pushing the origin of the channel back in time evades the main issue, for it does not help to explain its up-and-down profile.

CONCLUSION

It is hoped that the preceding discussion of certain types and systems of meltwater channels will help towards a better understanding of these features. The author is well aware that much has been omitted: for example, little reference has been made to the complications resulting from multiple glaciation, the concept of the englacial water-table has been mentioned only briefly, the possible implications of extensive drainage into the ice in terms of large subglacial and englacial river systems have been barely touched upon, and the depositional features produced by glacial drainage have been given insufficient attention. These omissions are in part simply a result of considerations of

space, but in part they too result from the inadequacy of our knowledge of glacial drainage features in Britain. Despite frequent statements to the contrary, we understand very little of the origin and significance of meltwater channels and related deposits. A great quantity of evidence stored in the literature needs to be re-interpreted and much additional evidence whose significance has not as yet been appreciated must be recorded. It is probable that as this is done there will be revealed a very different picture of the history of deglaciation in many parts of Britain from that which seems to be generally held at present.

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[2] It will be seen in Figure 5 that 26 channels terminate at about the same altitude (c. 450-475 feet). This might seem to suggest that these channels drained into an ice-dammed lake, an interpretation that might seem to be supported by the existence at the eastern end of Strath Allan of a large meltwater channel cut down from about 450 to about 400 feet, by which the lake might have overflowed. Such an interpretation, however, cannot be reconciled with the subglacial origin already suggested for the channels shown in Figure 5. The apparent anomaly can be resolved as follows. The large channel at the eastern end of Strath Allan carried the meltwaters eastwards out of the strath and controlled the level of the water in the strath itself to the west. But this water did not exist as an open lake. Numerous steep-sided kames, many of them with flattish tops at about 400 feet O.D., together with associated kettles, show that the floor of the strath was, in the later stages of deglaciation, occupied by masses of dead ice around which much of the fluvioglacial material was laid down, the upper limit of deposition being controlled by the large channel. At a slightly earlier (and partly contemporaneous) stage, when ice still covered the slopes shown in Figure 5, the meltwaters flowed down beneath the ice and eroded the channels, but erosion could not extend below the level of the large outlet channel at the eastern end of Strath Allan, for this controlled the level of water in the tunnels, crevasses and other openings within the ice itself. This level may be referred to as the 'englacial water-table'. The influence of the water-table on meltwater drainage in the Eddleston valley, Peeblesshire, has been discussed elsewhere (*Geogr. Ann., Stockh.*, 1958). The idea has been applied for some time in Scandinavia and plays a major part in Gjessing's (1960) interpretation of deglaciation in part of central Norway.

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SOME ADDITIONAL EARLY MAPS OF SCOTLAND

ALEXANDER B. TAYLOR

In the course of examining the sixteenth-century maps of Scotland as an aid to place-name study, the writer has come upon several which are not recorded in *The Early Maps of Scotland* published by the Royal Scottish Geographical Society in 1936. The originals of these maps are deposited in places as far apart as California and Copenhagen, London and Madrid, and some of them are of considerable intrinsic interest.

The purpose of this paper is to give a short descriptive note on each. These notes will be of a preliminary character, as the writer is engaged on a broad comparative study of the maps of Scotland in the sixteenth century from which, he ventures to hope, more detailed papers may emerge.

To see each new map in its setting, it is convenient to think of the sixteenth-century maps of Scotland recorded in *Early Maps* as belonging, for the most part, to one or other of five groups:

I. *The Ptolemy maps*, of which a number continued to be printed in the sixteenth century.

II. *The portolan sea-charts*, mostly decorative versions of the portolan charts of the preceding century. M. C. Andrews' studies of these charts remain unsuperseded. [1]

III. *The George Lily series*, the basic map of which was Lily's own map of the British Isles printed at Rome in 1546. It is included in *Six Early Printed Maps* published by the British Museum in 1928; and there is another edition, with a valuable commentary by Lynam [2]. M. C. Andrews [3] made a study of the Scottish portion of this map and of its imitations, but the source of this portion awaits further study.

IV. *The Mercator-Ortelius group.* This group has been so named because the best known items in it are Mercator's maps of 1564 and 1595, and Ortelius' maps of 1570 and 1573, the last being reproduced in *Early Maps*, plate IV. Other maps listed in *Early Maps* and belonging to this group are the larger map of Bishop Leslie, 1578, and the maps of Keer, Speed, Hondius, W. J. Blaeu, Jansson and Hollar. While each of these maps has its own separative peculiarities and errors, they have a general similarity in outline and in selection and form of place names such as suggests that they all belong to the same broad group.

V. *The Rutter charts.* The tables of sailing directions or "rutters" which became popular in the sixteenth century were accompanied on an increasing scale in the second half of the century by charts of the coasts to which the directions related. [4]

The first printed "rutter" of the coasts of Scotland which is accompanied by a chart is Nicolay D'Arfeville's *La Navigation du Roy d'Escosse Jaques cinquiesme.... autour de son Royaume....* Paris 1583. The chart accompanying this "rutter" takes the form of a frontispiece, and is reproduced in Plate VI in *Early Maps*. The relationship of the chart to the printed table of sailing directions is not quite clear. Each has peculiarities of its own, and this suggests that each has a separate

origin. The chart, moreover, has numerous affinities to the maps of the Mercator-Ortelius group, and the writer is at present studying these.

THE MAPS

NOWELL, LAURENCE.

A A small scale map of Scotland, in BM Cott. MS. Domitian A. XVIII, ff 98v-99r. No date. $7^1/_2$ in. $\times$ $10^1/_4$ in.

B A larger-scale map of Scotland in two parts in the same manuscript, the southern half being in ff. 104v-105r, and the northern half in ff. 106v-107r. No date. Each map $7^1/_2 \times 10^1/_2$ in.

Laurence Nowell, Dean of Lichfield (d. 1576), was a scholar and antiquary of some note. Among his papers are a group of small manuscript maps of England, Ireland, and Scotland, all preserved in the manuscript volume referred to above. Flower [5] dated the maps about 1564; but North [6] supplied evidence which suggests that the maps were more probably drawn a year or two later.

Compared with the engraved maps made in Antwerp and Amsterdam, Nowell's maps are the work of an amateur, albeit an industrious one. The small-scale map, for example, is so crowded with names—nearly 600—that many of them are difficult to read without a magnifying glass. It would appear that Nowell had been copying from a much larger map, and was trying to carry over as many names as possible. The larger-scale map has few names, and its two parts were perhaps drawn after his experience with the small-scale one. The small-scale map is nevertheless a beautiful little thing, with a most pleasing use of colour. The coast line is edged with blue on the sea-ward side and with yellow on the land-ward side. The mountains, drawn in profile, have a wash of greenish-grey. The names are in black or red. The larger-scale map, on the other hand, has no decorative features.

Both maps have similarities to the maps in the Mercator-Ortelius group, but have peculiarities which in some instances they share with one another and in some instances are special to either map A or map B. At some points, e.g. in the representation and naming of the island of Jura, Nowell has the only correct accurate cartographic rendering in the group; all the others in the group make the island too small and misname it Iona. Of special interest also is a large group of place names —over sixty—that are similar in form to the corresponding names in the map of Scotland in Mercator's *Atlas* of 1595, but not to the corresponding names in other maps in the series. Some of the similar forms, indeed, do not occur in the other maps in the group at all. The significance of this correspondence is not entirely clear, but it may be that Nowell's maps and Mercator's map of 1595 form a sub-group within the broad Mercator-Ortelius group.

NOWELL, LAURENCE. *The Lansdowne map*: a map of the southern half of Scotland, as far north as Arbroath, forming part of a manuscript map called "A general description of England and Ireland". In the collection of Lord Lansdowne. Photograph in BM (Maps 1080 (75)).

This map of Scotland is inferior in outline to the preceding maps of Nowell and is of less intrinsic interest. It has a random selection of place names—about seventy— similar to those in the smaller-scale map of Nowell or his larger-scale one or both. In some instances it preserves

a better spelling than Nowell's other maps; e.g. *Fast (castle)* for *Fals castle,* and *CARICKE* for *Carig.* Flower [7] thought that it preceded Nowell's other maps of Scotland in point of time, but it is difficult to be sure about this and about its relation to them.

BOWYER, WILLIAM. *Map of the British Isles. (1567).* Manuscript map in San Marino, California, Huntington Library MS H.M. 160. Photograph in BM, NLS.

This manuscript map is among the papers of William Bowyer preserved in the Huntington Library. Bowyer was Keeper of the Public Records in the Tower of London from 1567 to 1604. The name of Bowyer is used as a means of identifying this map, but it is unlikely that he himself drew it. More probably he had it drawn, acquired it in the course of his official duties, or had it copied from an official map among the records under his charge. Wright [8] has shown that he made a personal collection of manuscripts, and it is not unnatural that he should have had a manuscript map (or maps) among them. In its outline, this map is similar to the other maps in the Mercator-Ortelius group, and its place in the group will be the subject of a subsequent paper.

ANON. *Insula Britannia.* (c.1570). A wall map preserved in the Vatican Library. 214 cm. × 324 cm. Reproduction in R. Almagià, *Monumenta Cartographica Vaticana* (Biblioteca Apostolica Vaticana, 1944-55), vol. iv, plate I.

In his note on this decorative wall map, Almagià (*op. cit.,* pp. 7-8) says that the 'Scotia' part of it is based upon Lily's map of 1546, except for the Hebrides for which he postulates another source, unknown. The rendering of the Hebrides is certainly superior to Lily's, the shape and position of the islands intended to be Lewis and Skye being not unlike those in the Mercator-Ortelius group. The map has also a few place names not found in Lily but occurring in the Mercator-Ortelius group, *i.e., Thurso, Longue* (for *Tongue), Laco Broom,* and *Bullack* (apparently for *Bailnoheglis,* now *Heglish,* Assynt).

A comparison of these forms with the forms of the names as they appear in the Mercator-Ortelius group of maps suggests that this map of 'Scotia', while based upon Lily, was 'corrected' at certain points by reference to a version of a map (now lost) similar to the maps of Nowell described above.

The map is undated, and c.1570 is given tentatively. It may be earlier; but it seems unlikely to have been much later. Ortelius' *Theatrum Orbis Terrarum* was published first in 1570, and contains a much better exemplar of both Anglia and Scotia than those that the artist of the wall map seems to have had before him. Ortelius' *Theatrum* was widely disseminated, and if the artist had been working much after 1570 he would surely have had access to it.

MARTINEZ, JOAN. *Iscotia.* In a manuscript atlas compiled in 1587 by this Spanish cartographer. Madrid Biblioteca Nacional MS. V. 3. 5. Approx. 24 in. × 31 in. Photographs in BM, NLS, RGS, RSGS.

The existence of this map was apparently discovered by M. C. Andrews in the course of his map-searching visits to continental

libraries. The writer came upon a reduced photograph of it among the photographs of portolan charts which he bequeathed to The Royal Geographical Society, London. The Superintendent of the Map Room, British Museum, obtained a new photograph from Madrid (See Pl. 2). The broad outline of this map is similar to that of the maps in the Mercator-Ortelius group. This will be seen from an inspection of Plate 2 and of Ortelius' map 1573 in Plate IV of *Early Maps*. The selection and the form of place names are also similar. In some names, the form has an affinity to that in Mercator 1564, in others to Ortelius 1573. One or two of the names have been given a pseudo-Spanish form, e.g. *Lorno* for *Lorna* or *Lorne*. Others have been mis-copied, e.g. *Contire, lamond, lia* (for Ila). A more detailed study of the names seems likely to reveal more information about the position of the map in the group.

Martinez's map, however, differs from all the other known maps in this series in its technique. Martinez [9], a prolific creator of decorative portolan maps, uses in this map (and in the map of England in the same atlas) the conventionalised methods of representing coast-line, rivers and mountains which belong to the portolan tradition. The coast-line is a succession of semi-circular bays. All mountains are of approximately the same shape and size, and trees (all deciduous) grow in all the valleys. The photograph suggests that Martinez's map is, indeed, one of the most beautiful maps of Scotland in the sixteenth century. It is, of course, an artist's map rather than that of a cartographer proper. It is not, however, without cartographic interest, for it seems to provide some evidence which may help in elucidating the relationship between Mercator's map of 1564 and Ortelius' maps of 1570 and 1573.

DE JODE, CORNELIUS. *Angliae Scotiae et Hiberniae Nova Descriptio.* In his *Speculum Orbis Terrarum,* Antwerp, 1578. The map of Scotland is 9½ in. × 13½ in. In BM.

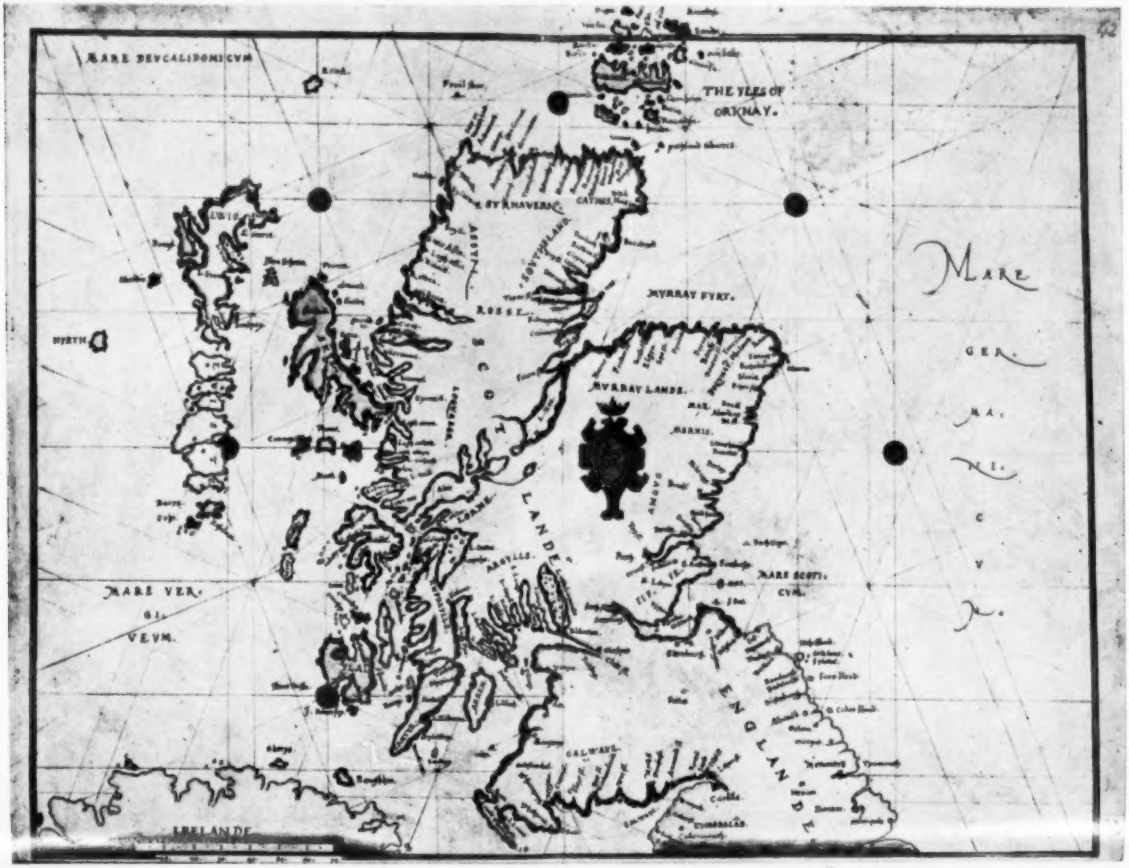
The map appears to be a copy of Ortelius' map of 1570.

WOUTNEEL, HANS. *A description of the Kingdoms of England Scotland and Ireland With al the Ilands adjacent vnto them, also the Battails that have bin fought.... expressed by the figures of tents, in their proper places....* London, 1603. It is inscribed *Graven by William Kip,* and is dedicated *To the Most Highe.... Prince Iames.* Original in Geographisches Seminar, University of Göttingen. Photostat in BM.

This map is the subject of a paper by Lynam [10]. He says that Woutneel was known as a Flemish bookseller who lived in London about 1585-1607, and was a correspondent of Ortelius. The map of England and Wales was based upon that by Hondius (1594), but the map of Scotland was based upon that of Ortelius, 1573. The battlefields, he says, appear to have been taken from Holinshed and other chroniclers. The engraving is fine, but, says Lynam, "except in Ireland and in the marking of battlefields the map shows no original research".

ANON. *Scotiae Pars.* University Library, Copenhagen, MS A.M. 22 fol., (a and b), f. 46. Early-seventeenth century. About 13 in. × 11 in. Photostat in NLS.

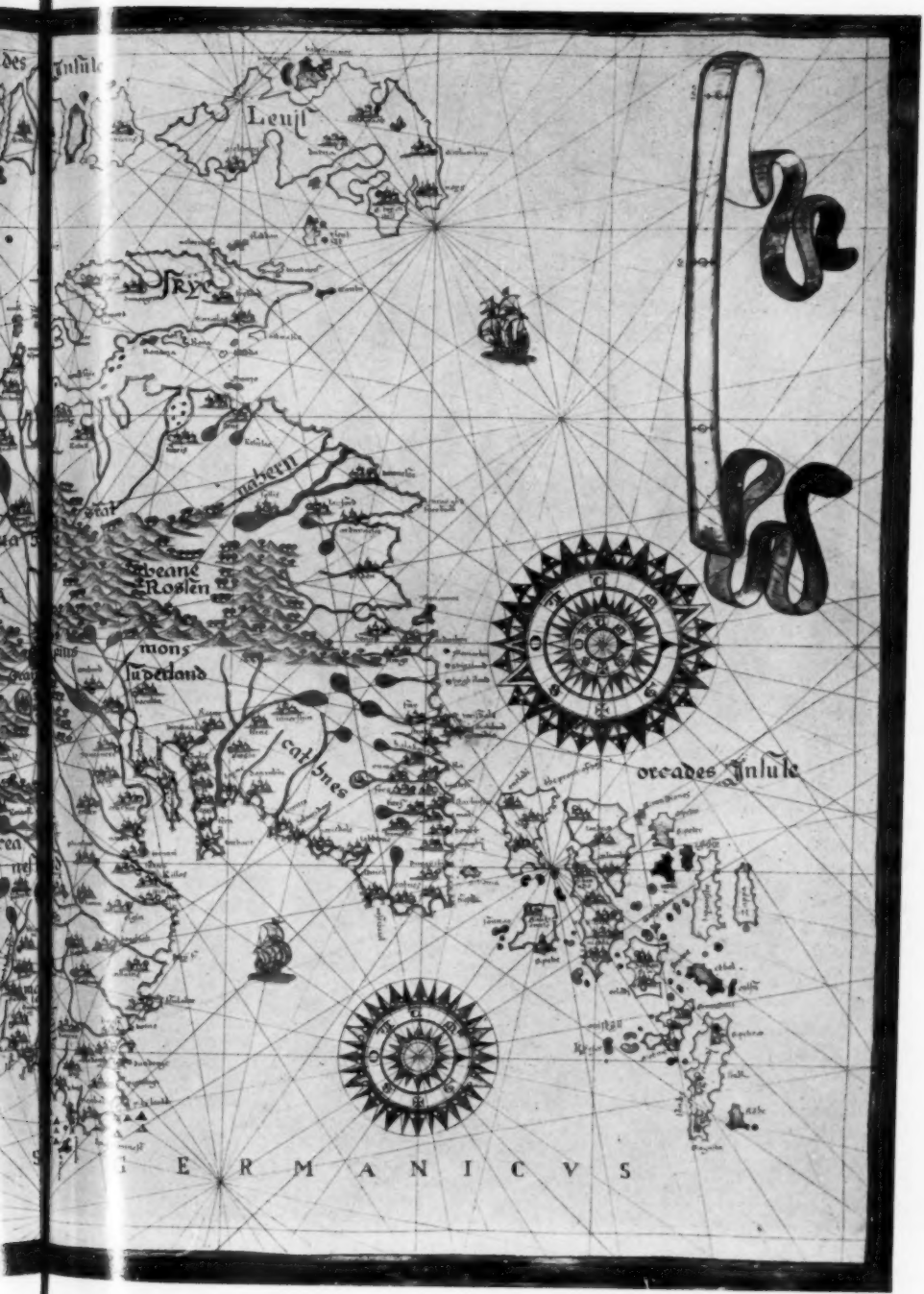
This is a roughly drawn manuscript map, of little cartographic interest, among a collection of notes on Scottish and English history.



Carte of Scotlande, Anon.
Late-Sixteenth Century.
BM.
Add. MS 37,024
Actual Size :
$8^{3}/_{4}$ in. × $11^{1}/_{4}$ in.

British Museum
Plate 1

Iscotia, Joan Martinez, 1587. Madrid Bibl. Nac. MS V. 3.5.
Actual Size : approxo 24 in. × 31 in.



Madrid Biblioteca Nacional
Plate 2

Plate 3 *Royal Air Force, Crown Copyright Reserved.*
Part of a system of meltwater channels situated on southern side of Strath Allan, Perthshire (see Fig. 5). Channels mostly less than 20 feet deep and some are benches. South is at top of photo; scale 1 : 10,000 approx.; Nat. Grid Ref. of centre point 27/839062.

Place names are inserted on the west coast and western isles and in Orkney; the rest of the map is blank. The outline and names are those of the Mercator-Ortelius group, the resemblance being closest to Ortelius 1570. All the names in the map are found in Ortelius 1570. There is the same position and division of *Gallo : /Way*; the same erroneous spelling *Langa* for *Lunga;* and the same spelling of most of the other names. Ortelius' *Skye* and *Hoy,* however, appear in Latinised form as *Skya* and *Hoia,* perhaps under the influence of one of the Scottish historians of the sixteenth century. It would seem that the map is based upon Ortelius 1570 or of a copy thereof.

NICOLAY D'ARFEVILL, NICOLAS DE. *Charte de la Navigation du Royaume d'Escosse.* In an undated manuscript version of Nicolay's *La Navigation du Roy d'Escosse,* Paris, 1583. Berlin, Royal Library, MS Hamilton 38. 11 1/2 in. × 15 1/2 in. Photograph in BM.

The existence of this chart came to the writer's notice in a bibliography by Ruge [11] of cartographical material in German libraries. It is a variant of Nicolay's printed chart of 1583.

ANON. *The Carte of Scotlande.* Late-sixteenth century. In BM Add. MS 37,024, ff. 41v-42r. 8 3/4 in. × 11 1/4 in. Photostat in NLS, RSGS.

This manuscript has a long title, the relevant parts of which read :– "The Booke of the Sea Carte, called the Rutter, which sheweth the tydes, courses, kennynges, floodes, ebbes, havens, roads, soundes, and daungers, about the whole of Britannye.... with cartes and other necessary thinges appartaynynge...." The rutter of the Scottish coasts is in ff. 3v-15r, and the *Carte* of Scotland is the first of a short series of charts on vellum at the end of the volume. The Keeper of Manuscripts of the British Museum has given the opinion that the hand in the text of this manuscript appears to be of the late-sixteenth century.

The *Carte* (Pl. 1) has both cartographic and artistic interest. To take its artistic qualities first, it is neatly drawn, with some degree of decoration and considerable–although not very systematic–use of colour. The narrow border is maroon. A crest, over the Central Highlands, is in gold on purple. Yellow "loxodromes" radiate from vermilion dots about a quarter of an inch in diameter. The coast lines are edged on the landward side in greenish-yellow, except in Uist, Arran, and Jura, where blue is used. There is a wash of paler yellow over the inland parts of some islands–Skye, Islay, Hyrth, Barra, Orkney, Coll, and N. Rona. Some islands, however, are blue all over–Sanday, Fara and Rousay (Orkney); Canna, Muck, Colonsay; and some other smaller islands. The general effect is pleasing, but the map is much less ornate than some of the portolan charts of Italian and Spanish cartographers.

Of cartographic interest are the affinities between this chart and Nicolay's manuscript chart (mentioned above) and his printed chart of 1583. Similarities in outline and in selection and form of place names suggest that the three charts form a single group of "rutter" charts with a common source. This chart also has the distinction of being the only map that the writer has found to contain the Gaelic name *Hyrth* correctly applied to the islands which have been known to cartographers as *St Kilda* since the seventeenth century.

RYTHER, A. Scotland in the 'Armada' chart of the British Isles. This map is the last of a series of charts illustrating the defeat and escape of the Spanish Armada, the series being associated with *A discourse concerning the Spanish Fleete.... Written in Italian by Petruccio Vbaldini and translated by A. Ryther,* London 1590. 20 in. × 28 in. Drawn by Robert Adam (1588), and engraved by A. Ryther. Reproduction in *Lord Howard of Effingham and the Spanish Armada with exact facsimiles of the Tables of Augustine Ryther A.D. 1590,* ed. H. Y. Thompson, Roxburghe Club 1919. Originals in BM; Pepysian Library, Cambridge; and a fine coloured copy in St John's College Library, Cambridge.

The Scottish part of this interesting chart is based, although apparently indirectly, upon Ortelius' map of 1573—with the addition of Shetland from some other source. The outline is not well done, being even broader in relation to its length from north to south than that of Ortelius. There are about seventy names of coastal towns and features and of islands. The most interesting aspect of the chart is a sketch of an attenuated Spanish fleet being pursued into the North Sea by an English fleet; and then there is a line showing the escape route—north of Orkney and South of *Faire Il* and *Fowlie* (Foula), and so round the west coast of Scotland and Ireland. (These two small islands appear, it is interesting to note, as early as Mercator's Globe of 1541, in the forms *feril* and *fule, Foele.)*

WAGHENAER, L. Charts of East Coast of Scotland and Orkney and of Hebrides; and of Shetland. In *Thresoor der Zeevaert,* Amsterdam, 1592. Each chart about 8 in. × 10 in.

No copy of this notable Dutch collection of rutters and charts is known to exist in this country. The British Museum Map Room has a copy if the French edition of 1601, on which Lynam [12] has written an interesting note. It is entitled *"Thresorie ov Cabinet de la Rovtte Marinesque....* Lucas Iansz. Wagenaer. Calais, 1601". In this edition, the Scottish section is as follows :—

Description of the east coasts of the North of England, and of Scotland and Orkney, pp. 134-140.
Charts, covering two pages, of the east coast from Whitby to Orkney, after p. 134.
Chart of Hebrides and "S : kilda", p. 140.
Profiles of coast-line features of various parts of Scotland, p. 138.
Description of the coasts of Shetland and Faroes, pp. 141-145.
Chart of Shetland, after p. 140.

Lynam notes that this edition bears the imprint of Bernard d'Aseville, Calais, but adds that "there are many indications, notably the bad French of the text, that it was printed in Amsterdam" [12].

The charts and the rutters that they accompany have numerous points of resemblance to those in Nicolay's *La Navigation* (BM Add. MS 37,024.) and a detailed study will be necessary to establish their relationship.

BLAEU, W. J. Charts of the East Coast of Scotland and Orkney; of Hebrides; and of Shetland. In *Licht der Zeevaert,* Amsterdam, 1608.

This Dutch book of rutters and charts seems to have been lost, but there is an English edition of it in the Map Room of the British Museum with the title *"The Light of Navigation....* by William Iohnston. Am-

sterdam, 1612". An inspection of the Scottish section in this edition (Book II, pp. 100-8) shows that Blaeu's work is a copy of Waghenaer's in his *Thresoor* described above. "William Iohnston" is a translation of "Wilhelm Janszoon" (Blaeu).

The writer could not have prepared the above notes without help and guidance from many sources. He is deeply indebted to the staffs of the British Museum, the National Library of Scotland, the Libraries of the Royal Scottish Geographical Society and the Royal Geographical Society, the Pepysian Library and the Library of St John's College, Cambridge, the Public Record Office, and Huntington Library, California. He is especially grateful for advice and encouragement from Mr R. A. Skelton, Superintendent of the Map Room, British Museum. All opinions expressed, however, are the writer's own unless expressly attributed to some one else.

For permission to reproduce the two maps the author is grateful to the British Museum and the Biblioteca Nacional, Madrid.

[1] Andrews, M. C. Scotland in the Portolan Charts *S.G.M.* 1926, 42, (3) : 129-153; (4) : 193-213; (5) : 293-306. The boundary between Scotland and England in the Portolan Charts, with a list of charts, *Proc. Soc. Antiq. Scotl.* 1925-6 : pp. 36-66.

[2] Lynam, E. *The Map of the British Isles of 1546.* Jenkintown, Pennsylvania, U.S.A., 1934.

[3] Andrews, M. C. Notes on the earliest-known printed map of Scotland, *S.G.M.*, 1919, 35 (1) : 43-46.

[4] For comments on the various rutters of the Scottish coasts, see Taylor, E. G. R., *Tudor Geography*, 1930, pp. 17, 59-63.

[5] Flower, R. Laurence Nowell and the Discovery of England in Tudor Times, *Proc. Brit. Academy*, 1935.

[6] North, F. J., *Humphrey Lloyd's maps of England and Wales*, Cardiff, 1937, p. 55.

[7] Flower, R. *Op. cit.*

[8] Wright, C. E., The dispersal of the monastic libraries and the beginning of Anglo-Saxon Studies. In *Trans. of the Cambridge Bibliographical Society*, 1951 vol I, pp. 231-2.

[9] The principal study in English of Martinez's work is Julio F. Guillén y Tato, An unpublished atlas of J. Martinez (1591), *Imago Mundi*, 1955, 13 : pp. 107-126. (This is a different atlas from the one that contains the map of Scotland described in the present paper).

[10] Lynam, E., Woutneel's map of the British Isles, *Geogr. J.*, 1933, 82 (6) : 536-38.

[11] Ruge, W. Aelteres Kartographisches Material in deutschen Bibliotheken; in Bericht V, *Nachrichten von der Königlichen Gesellschaft der Wissenschaften zu Göttingen*, Phil. Hist. Klasse, Beiheft, Berlin, 1916, pp. 63-4.

[12] Lynam, E., Lucas Waghenaer's Thresoor der Zeevaert, *British Museum Quarterly*, 1939, 13 : pp. 91-4. See also Gernez, D., Lucas Janszoon Waghenaer, *The Mariner's Mirror*, 1937, 23 : pp. 190-7, 332-50.

THE AEROPLANE AND CANADIAN MAPPING

A. C. TUTTLE

Today no mapping in Canada is undertaken without aerial photographs. It, therefore, is evident that the aeroplane has an effect on every modern map. It is equally important to realise that the aerial photograph, important as it is, is *not* a map and that its full value can be attained only when it has been adjusted to fit a framework of ground control.

The need for suitable mapping is a common prerequisite to every form of national development. Highways and railways require topographic maps for proper selection of routes, as do transmission and pipe lines. Maps are necessary for the study of forest and mineral resources, water-power potential, irrigation, agriculture, the development of tourist-resort areas, and they are indispensable for national defence. In fact, there is probably no aspect of modern civilisation that does not require maps of some kind at some stage.

In preparing maps for resources development, especially mineral resources, the Topographical Survey is very closely associated with the Geological Survey; in fact, the Topographical Survey of the Department of Mines was originally formed as a division of the Geological Survey, for the express purpose of making the ground survey and drawing the base map on which to delineate a geological report. This work continues to be one of our major functions although we now have many other responsibilities.

In the early part of this century the preparation of maps for a country as large as Canada seemed a Herculean task and, with limited facilities and a small population located in a narrow fringe along the south border, the possibility of mapping northern areas was remote indeed. But two important things happened. Minerals were discovered, as men pushed northward on foot, by canoe and dog-team. And, in the nineteen-twenties the aeroplane ceased to be a novelty and became a medium of transport. Now the prospectors and geologists could move—and they did! So maps became an immediate necessity, both for air navigation and for mineral exploration.

It was apparent, of course, that aircraft could carry cameras as well as men and equipment, so our early photogrammetrists, Deville, Narraway, McKay, Carroll, Davidson, Burns and others set about the task of plotting maps from air photos. Oblique pictures were used, since the aircraft could not fly very high in those days, and from those early efforts came the well-known Canadian Oblique Method of plotting. Basically, the method consisted of preparing a perspective grid dependent on the focal length of the camera lens, the flying height and the angle of depression, superimposing this grid on the oblique photograph in the proper position and transferring detail to a manuscript on which a corresponding rectangular grid has been drawn. It was used in plotting reconnaissance maps of large areas of northern central Canada. This method was developed and expanded and, as the planes gained in altitude, it was possible to mount three cameras, one vertical and one oblique on either side, and thus came trimetrogon photography.

The planimetric maps produced from oblique and trimetrogon photos at reconnaissance scales of 1 inch to 4 miles and 1 inch to 8 miles, and sparsely controlled by astronomic observations, have served a very valuable double purpose. They are the base on which the aeronautical charts of all northern areas are prepared, and they have also been the maps for widespread mineral exploration.

Following World War II, the aeroplane became a prime medium for a number of developments that affected the mapping programme. One of the first of these was the provision, by the Geodetic Survey and the Royal Canadian Air Force, of a strong network of ground control across the Northwest Territories and the Arctic Islands. This was accomplished by using an electronic instrument known as 'Shoran' for measurement of the lines in a huge trilateration not covering the entire area. Fundamentally, this method consists of mounting the equipment in an aircraft, flying it across a line joining two ground stations and recording the time required for a radio wave to pass between the airborne set and each of the ground stations. Using the smallest recorded time and applying the proper corrections, it is possible to compute the length of the line and by thus measuring each side

of a triangle, a trilateration scheme can be built up and positions determined for all the stations.

A little later, the same method was used to position control flights of aerial photography forming a grid pattern across the Northwestern part of the Territories and along the Arctic Coast as far east as Baffin Island. The fixing of the position of an aircraft at the instant the vertical photograph was exposed was accomplished by continuous simultaneous measurement to two fixed ground-stations so that every photograph could be positioned as the aircraft moved along the flight line.

Another important development was the Airborne Profile Recorder. This instrument measures the vertical distance between the aircraft and the ground and it is thus possible to produce a continuous profile of the terrain over which the plane has flown. The original purpose of this equipment was to assist in aeronautical charting and vertical information from A.P.R. profiles has been used extensively in recent years to add topographic information to both 1/500,000 and 1/250,000 mapping.

A very useful product of the aeroplane and aerial photography, and one that is used extensively in preparing to map unsurveyed territory, is the uncontrolled mosaic. When the vertical photographs have been skilfully pieced together and reduced by photography to an approximate scale of two or three miles to one inch, the resulting picture of the country is invaluable for any operation involving the use of aircraft. Visual navigation is simplified, triangulation nets can be tentatively laid out in advance, rock outcrops can be marked for easy ground examination and general topographic, geographic or geological features become readily apparent. Mosaics have already been prepared for more than half of this country and it is probable that this coverage will be extended over much of the remaining portion.

With coverage of Canada virtually complete at the 1/500,000 scale, the next step is to provide more detailed and accurate maps at 1/250,000 on which interesting mineralised areas can be shown. This work is at present being accelerated as much as possible and each year field parties are putting in ground control over extensive areas in order to provide topographic maps with better scale and accuracy, to meet the requirements of modern methods of exploration and development. For those areas where extensive development is warranted, detailed maps at 1/50,000, with appropriate contour-intervals will be produced as promptly as possible. Unfortunately, the staff and facilities of the mapping agencies have not always been adequate to provide maps ahead of the requirement.

MAPPING OF CANADA

In 1939-40, 16 field officers carried out control surveys at various scales, covering an area of about 22,000 square miles and a substantial part of this work was for planimetric maps only. In 1959-60, three major field-parties equipped with helicopters and fixed-wing aircraft and staffed by 17 field engineers, completed topographical control of 65,000 square miles of 1/50,000 mapping, plus 131,000 square miles of 1/250,000 mapping.

In 1939-40, the Annual Report showed a total of about 48 full map-sheets, at scales of 1 inch to 1 mile and 1 inch to 4 miles. In the calendar year 1959, 237 map-sheets at 1/50,000 and 20 sheets at 1/250,000 were forwarded by Topographical Survey for reproduction. Map Compilation and Reproduction Division reports publication of 174 new sheets at 1/50,000 and 26 sheets at 1/250,000 for the same period. The increase in new mapping forwarded for reproduction, and this is the matter of interest because it is available in the form of advance information, is almost directly the result of the use of aircraft, first as a means of rapid transportation of field crews and second, as a platform from which to obtain vertical air photographs. The difference shown by these figures is even more pronounced when it is considered that surveys in 1939-40 were largely in relatively civilised or settled areas whereas much of the work in 1959 was in remote country where surveys using ground methods and transport would be difficult, slow and very costly.

The speed and ease of movement in the lake-studded terrain found in most parts of Canada, coupled with the possible utilisation of every fine hour increases the potential of each field officer tremendously. In 1938, with pack-horse transport about two-thirds of a 1/250,000 sheet was covered near Mayo, Yukon Territory,

and it was a long, hard season. In 1959, while organising a large helicopter party in Mayo, we completed the ground control for a similar, but more remote, sheet in a matter of about ten days, as a sort of by-product. In this case we did not even use the helicopters but we did toss in two additional observers and moved them by fixed-wing aircraft. The flexibility possible with this modern 'pack-horse' enables an experienced party-chief to get four or five times as much utilisation of men and equipment and the general efficiency and accuracy of work is much greater.

While we have been making wide and effective use of the helicopter for more than ten years, its potential value was increased abruptly with the 1957 debut of of tellurometer. This instrument, which gives precise measurement of distance up to thirty-five miles, was immediately allied with the helicopter and the one-second theodolite and a field party so equipped can be expected to complete two to three thousand miles of excellent traverse in a three-month season, sometimes making over 100 miles in a single day. This tremendous capacity can only be realised, of course, in country where clear line-of-sight is possible.

The remarkable increase in speed of mapping is, of course, not all due to the aircraft as a transport medium. A sizeable part of the increase must be credited to the use of the aircraft as a camera-carrying platform to provide vertical photographs from which the intricate pattern of features on the ground can be accurately transferred to the manuscript. The use of such photographs has brought about tremendous changes in the density of ground control as well as in the methods to obtain it. Where it once was necessary to cover parts of an area with many points laboriously located by triangulation or traverse, and stadia or spirit levels, we can now fix a thin line of traverse points around the perimeter of an area, put in strategically located barometric levels at certain intervals and pass the job on to the operator of a photogrammetric plotting instrument. By a series of instrument readings and adjustments, errors in the photos caused by tip and tilt of the aircraft, height distortion, etc., are determined, adjusted, and the contours and ground detail are then plotted on the manuscript; and this is all accomplished in the office.

Barometric levelling is being widely used for vertical control for photogrammetric mapping of the undeveloped areas in Canada. Basic control consists of spirit-level lines along rivers and lakes, supplemented by vertical angles measured along tellurometer traverse-lines. Overlap control-points are selected in advance to give a density appropriate to the scale of photography and the method of mapping and the heights are determined by a precise altimeter carried in a helicopter from one basic control point to another, with readings made at all intermediate points. Such a flight is made in a reasonably constant direction and the elapsed time between readings at the basic control points should be kept within one to one and a half hours. Recording altimeters at known points in the area provide information on pressure and temperature changes to be applied in adjusting the raw readings.

What remains to be done? Much. Although great strides have been made in our mapping there are many great northern areas almost unexplored. And there are many southern settled areas where existing maps are so out-of-date that they have lost most of their value.

The immediate object of the mapping agencies is to cover the entire Canadian mainland and Arctic Islands with reconnaissance topographical maps at a scale of 1/250,000 and to complete coverage of settled districts, major transportation routes and areas of strategic or economic importance, with detailed topographical maps at 1/50,000. The latter part of this proposal includes revision and re-plotting of many old, out-dated maps.

At the reconnaissance scale of 1/250,000 approximately 940 map sheets are needed to cover Canada; in 1959 about 230 had been published or completed, and another 185 were in hand. In addition, large areas are covered by maps, or control, at the 1/50,000 scale and these need only compilation at the reduced scale to produce a substantial number (about 100) of the 1/250,000 series. When these are all added up, it appears that about 55 per cent of our mapping at this scale, is either published, in hand or controlled. Unfortunately, some of the most difficult country has yet to be done, notably Baffin and Ellesmere Islands. It is safe to predict that every known photogrammetric technique will be fully utilised in the mapping of these inhospitable regions.

In considering the programme of 1/50,000 mapping, completed or proposed, evaluation by percentage is both disappointing and unrealistic. There are about fifteen to sixteen thousand sheets in the total area, but it is safe to assume that many large sections of 'moose pasture' in the north will not require detailed maps within the foreseeable future. Continued exploration and development will undoubtedly require extension of the 1/50,000 series beyond present expectations, but it is believed that the coverage published, completed, or in hand, to be approximately 30 to 40 per cent of the total requirement, as foreseen at the present.

Revision of out-dated maps has become a most urgent problem and a start on this work has already been made. Some of these maps must be re-drawn, others only require revision of cultural detail. In all cases, new air photography is a prerequisite, (and here the aircraft will again play the initial rôle but there is no object in taking new photos until equipment and personnel are available to process the material. At present, and for the next years our resources must be largely directed toward completion of the reconnaissance mapping.

In conclusion, it should be noted that the mapping situation as outlined in this paper includes work done by provincial as well as federal mapping agencies, and the 1/250,000 programme in the northern mainland and Arctic Islands will be a co-operative effort by Army Survey Establishment R.C.E. and Topographical Survey. Mapping photography is now being obtained, shoran-controlled aerial photography is available for some portions, and aircraft support will be used throughout the area. This is further evidence that the aircraft is an indispensable asset in modern mapping. It should be added that the Topographical Survey has very recently demonstrated another application of the aircraft to control surveys—a method of accurate measurement of distance between points that are not intervisible. This is accomplished by carrying two tellurometers in an aircraft and reading to the points on the ground by a line-crossing technique. Results of tests are most encouraging and the use of the airborne tellurometer to provide trilateration control in many bush-covered areas of low relief is anticipated.

We can expect that other future developments will bring about a continuing increase in the efficiency and accuracy of mapping techniques and it is safe to say that the use of the aircraft, in one form or another, will be a highly important factor in such developments.

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THE SYMPOSIUM ON NATURAL RESOURCES IN SCOTLAND

It has been reported that the principal comment of a group of industrialists who recently toured Scotland at the invitation of the Scottish Council (Development and Industry) was to the effect that they had been unaware of the resources and advantages of the country. Within Scotland too there is frequently shown a similar lack of knowledge and understanding, though here it is perhaps more common to *over-rate* the potential and to *under-rate* the problems of developing it. Widespread interest attaches, therefore, to the Symposium on Natural Resources held in Edinburgh, November 1960, for its proceedings (which are shortly to be published) will provide a large and up-to-date body of information about Scotland's development prospects and problems.

The scope and scale of this Symposium distinguish it from the many previous reports on particular resources, problems and regions. Scotland, at any rate, has never had anything quite like it. Over a period of three days 53 papers on 26 resources were presented to over 250 delegates from industry, government and university. While, in general, earlier conferences have been mainly of local or specialist interest this one contained something for nearly everyone with an interest in Scottish development; for geographers it provided a factual statement on several aspects of the physical, economic and social geography of the country, on what we know and do not know about them, and on the inter-relationships between various trends, forces and policies.

The Symposium was planned and organised by a Committee of the Scottish Council (Development and Industry) with apparently the primary intention of providing facts on which to base the Council's research and promotional work. However, this could probably have been done without a large and public conference, and it is in the other purposes that the Symposium was intended to serve that we find its main significance and promise. The meeting was essentially an attempt to counteract the current tendencies towards over-specialisation and the disintegration of knowledge, by encouraging the cross-fertilisation of ideas between experts, and a wider public interest in and understanding of questions of resource development and conservation. In the words of Mr L. A. Elgood, Chairman of the Organising Committee, the aim was "a review in which resources are regarded as an integrated whole".

This approach is evident in the composition of the Organising Committee, and the issuing of invitations to industrialists, scientists, civil servants, teachers, planners, farmers, tourist and recreational authorities, amenity societies, politicians and trade unionists. It lies behind the comprehensiveness of the programme, and the inclusion in it of papers on multiple-purpose development and on conflict between resources and authorities. And it accounts for the widespread interest and support.

Comprehensiveness in this instance does not mean merely a superficial survey, for the Symposium has presented a wealth of facts and detailed studies. Neither does it mean a full study of *all* the potential resources, but rather the focussing of attention on important relationships and the simultaneous consideration of survey, analysis, utilisation, administration and policy. This brief report on the Symposium discusses what it showed to be the result of our failure to perceive these relationships and to adopt integrated development programmes, and also what it showed that we do *not* know about the country. Its value as a summary of what we do know has been already acknowledged, and the planning and development that it may stimulate remain to be seen.

In the discussion of basic resource facts the Symposium drew public attention to the gaps (well-known to specialists) in our knowledge about the physical environment and the natural resources that it contains. For facts on climate, for example, we are dependent on a limited number and an erratic distribution of recording stations, and on inadequate techniques and equipment for measuring evaporation and run-off, with the result that we are largely ignorant of the nature and trends of the climate of different sub-regions, of the variation in mountain climates, and of the micro-climatology of important agricultural and building sites. Similarly, detailed knowledge of the soils of Scotland is not available, and, though the notable work of the Macaulay Institute is proceeding as fast as its resources will permit, so far only a small part of the country has been covered, and, according to the estimates of Dr Glentworth, it will probably take 25 years to complete the work. Well has it been said (by Professor Wreford Watson) that an

atlas of Scottish resources would be, in some respects, an atlas of ignorance!

Water is one of Scotland's most abundant resources, and yet also one of its biggest problems, for the periodic flooding of some of its rivers is costly and troublesome, while in other regions the supply of water is insufficient for all the demands placed on it. In spite of its importance water has not been given enough consideration in Scotland (nor in any other part of the British Isles), and it is to be hoped that the findings of the Symposium in this respect will be given careful study. Many more records are required of the volume and variation of flow in Scottish rivers, but for these to yield reliable and useful data it is essential that recording apparatus be distributed amongst different rivers and along their channels in a systematic manner. For this a properly organised co-ordinated survey is necessary along the lines of those that most other countries have initiated. At the very least there is a need for more co-ordination of the aims, methods and records of the many authorities which presently make some flow measurements for their own purposes.

Co-ordination is equally necessary in regard to the demand for water. The Symposium showed the increasing conflict between large water-users. The need to modify hydro-electric schemes in the interests of the fish and tourist resources of a river valley, and the right of the community to prohibit pollution of its water-bodies are now generally accepted. New conflicts however are arising with the increasing demand by agriculture for water for irrigation, the heavy abstraction of water by new chemical and electro-metallurgical plants and by pulp mills, and the growth of the urban areas. To meet the demand we need to know how much water we have got in each region, and the present and likely future rate of consumption. For this regional surveys are necessary, and also comprehensive regional plans which will co-ordinate the distribution of water supplies and water-users.

Professor Pearsall has charged that man has created semi-desert conditions over a large part of the land of Scotland, with consequent deterioration, depopulation and erosion. While many factors have contributed to this process the essence of the problem is the general disregarding of basic ecological facts and relationships. Some of these are not even known; the Symposium heard of the lack of knowledge of the precise effects of a large plantation on the land adjoining it and how these are modified by differences in silvicultural practice. Similarly, information is lacking about the value of plantations as shelter belts for hill-farming, and the effect on the plantations of the methods used in pastoral management. For information on these and other inter-relationships involving several resources, co-ordination of the research programmes of the independent authorities is necessary. It may be that this, in the words of Mr MacDonald of the Forestry Commission, "could be dealt with quite satisfactorily by existing organisations working to an agreed plan", but some co-ordinating committee, planning board or government department has first to prepare such a plan.

That some sort of co-ordination is also required in the field of energy production in Scotland was one of the principal conclusions of the Symposium. In long, confident papers each of the energy authorities (coal, gas, hydro and nuclear) argued their special contribution to Scottish development. In view of present government policy it would be academic to consider whether in overall terms the total benefit might not be greater given closer integration of the investment programmes. However even within the context of free competition between energy resources, the need for a comprehensive approach is clearly shown by the facts presented to the Symposium concerning by-products utilisation, and by the effects of the location of power plants on the employment and amenity of various parts of the country.

Throughout the Symposium there was a tendency to talk about physical and economic targets and achievements without much thought being given to what these meant in terms of the movement, employment and welfare of *people*. However, on the final day human resources were given some consideration, on the reasoning that the size and quality of the population are factors in the development of the country's physical resources.

From this point of view it is of interest that (as shown by Mr Kyd in his paper on emigration and depopulation) the well-known loss to Scotland of skilled people in the 15-44 age group is offset by an influx of people from England, which suggests that the emigration of the Scots may not be due to an absolute lack of

opportunity here. On the face of the evidence presented to the Symposium it would appear that the Scottish educational system may be at least partly to blame in failing to produce a high enough proportion of people with developed scientific or technological ability.

Some disadvantageous consequences are apparent in the distribution of the population of Scotland. Depopulation of the northern and southern upland areas is taking away the local labour force and discouraging the improvement of the social capital, both of which in turn lead to further depopulation. And the related heavy concentration of people and activity in congested urban areas in Central Scotland is inefficient in economic terms and harmful to welfare and amenity. In this connection the further development of the indigenous resources of the country may be fully justified for its contribution to social, demographic and regional problems even though (as argued by Professor Peacock) a higher average level of per capita production and income might be obtained from specialisation, concentration and the use of imported materials.

However, this requires comprehensive regional planning rather than the customary *ad hoc* approach to the spatial and temporal distribution of investment capital. It also requires a wide and flexible definition of what we mean by 'resources' and their 'development'. It may be, for instance, that Scotland's most valuable resource is its natural and historical scenery, and that the exploitation of this by the tourist industry provides the optimum form of development for much of the country, as well as being a form of pump-priming for the revitalisation of particular regions.

These thoughts are prompted by the paper which Mr Nicolson of the Scottish Tourist Board presented to the Symposium. In this it was shown that the provision of piped water and electricity in Skye, new roads and ski-tows in Speyside, improved rail and bus services, advertising campaigns and recreational courses have brought a great increase in the tourist trade of the country. But it is likely that additional benefits could be obtained if integration were carried a stage further to embrace, for example, the production and marketing of local agricultural and other produce to meet the needs of the visitors.

From this brief comment on some of the matters discussed by the Resources Symposium it will be seen that its potential contribution to Scottish development extends far beyond the mere provision of an up-to-date compendium, valuable though this is. The official intention of the Organising Committee is to select from the half-million words in the recorded proceedings such recommendations as seem necessary or desirable, and to send these to the appropriate governmental authority. It is unlikely that a major change in governmental policy will be required to implement these recommendations, for as a matter of course a great deal of economic, social and physical planning is already undertaken without question by numerous bodies. The problem is, in fact, a relatively simple administrative one ; the Symposium has shown that to increase our knowledge of Scotland we need not merely more research but *integrated* research ; and that to improve on the use we make of our resources we need not more planning but *co-ordinated* planning.

P. D. McGovern.

NEWBIGIN PRIZE

The Council of the Royal Scottish Geographical Society announce that the award offered for the Newbigin Prize is £20 for the best essay not exceeding 7,000 words on any subject relating to Scotland, suitable for publication in the *Scottish Geographical Magazine*. Two copies of essays for the prize should be submitted to The Secretary, The Royal Scottish Geographical Society, Synod Hall, Castle Terrace, Edinburgh 1, not later than 1st September, 1961.

THE DESIGN OF ORDNANCE SURVEY MAPS

In the September edition of the *S.G.M.* an intesting article was published by Mr D. R. Macgregor on "Geographical Reflections on Modern Mapping". In this article some criticism was expressed of the amount of information shown on the six-inch and 1/25,000 maps of the Ordnance Survey and it was suggested that on both scales extra information should be included "concerning the character of streams, the extent of floodable land, types of vegetation, and the nature of industrial premises". In this respect the Ordnance Survey maps were compared unfavourably with those of other countries.

The extent and nature of the information shown on Ordnance Survey maps at all scales is constantly under review and there must always be room for improvement. On the other hand there are certain factors which must guide the selection of what to show and what to omit at each scale which may not always be apparent. As a national mapping organisation the Ordnance Survey has to design its maps on each scale to suit the most probable general requirements at that scale. It is frequently extremely difficult to discover what are in fact these general requirements since the most vocal elements of the public are often specialists who have conflicting interests. It does its best however to provide a general map which carries the essential information appropriate to that scale and which satisfies the majority of users, and at the same time it seeks to provide for the specialist users a suitable base on which they may add the extra information required for their own purposes. The outline editions of the 1/25,000 and smaller-scale maps are designed especially for this latter purpose.

The weight to be given to the respective conflicting interests will vary according to the scale of the map. At the quarter-inch scale the needs of the motorist will clearly outweigh those of the hiker, but the airman has also to be considered, and he wants more emphasis placed on such landmarks as railways and electricity transmission lines than the other map users may consider necessary. At the one-inch scale both the motorist and the walker have to be considered as well as planners and general users of all sorts. Much information is necessarily omitted and built-up areas in particular are very generalised. In considering for instance how to show the motorways on this scale it was necessary to ensure that the motorway though prominent should not dominate the map, and that the interests of other users were not subordinated to that of the motorist.

At the medium scales of six-inches to one mile and 1/25,000 field boundaries and very much greater detail of buildings and their names are shown. However in the interests of economy of production (and thereby of the reduction in the cost of the map) and to enable revision to be carried out more easily and frequently, these two scales of map will in future be produced from a single set of drawings. This measure will therefore lead to a slight reduction in the amount of detail that can be shown on the six-inch map since all detail shown on this scale will be reduced and shown also at the 1/25,000 scale without further generalisation. The saving in production time and costs are however considered to outweigh the slight loss of information at the six-inch scale.

Finally at the large scales of 1/1,250 and 1/2,500 which cover the whole country except for the mountainous areas, it is possible to show very considerable detail including the names or numbers of most houses and the acreages of individual fields.

The less information a map carries the easier it is to read the information shown on it, and minor information which can suitably be shown at a larger scale is therefore often best omitted at the smaller scales. In comparing the Ordnance Survey maps at the medium scales with those of other countries it is important to remember the extent of the large-scale coverage of Great Britain which does not exist elsewhere. Since so much detailed information is available on the large-scale plans it is not necessary or desirable to repeat this information on the smaller scales, and all the maps covering the same area at the different scales must be seen as a whole in relation to the overall information given.

Experiments are now in hand regarding the classification of vegetation and the extent to which this information can be extended and incorporated on the maps. Suggestions for improvement in the content and design of Ordnance Survey maps are always welcome and are carefully considered but such changes as are made must be considered against the above background.

Ordnance Survey

REVIEWS OF BOOKS

EUROPE

A Social Geography of Belfast. By E. Jones. $8\frac{3}{4} \times 5\frac{1}{2}$. Pp. XIV + 299. 10 plates, 75 maps and diagrams. London: Oxford University Press, 1960. 35s.

Belfast, in its present form largely Victorian, grew rapidly in the last twenty years of the nineteenth century. Lacking the Georgian graciousness of Dublin, it still retains some dignified buildings of the early-nineteenth century and some fine town houses now used for offices. Much of its centre and virtually all its shipbuilding area is on reclaimed land, but above this flat expanse there are ridges of sand, gravel and clay and beyond them the basalt uplands to the west and the lower hills to the east. This site, of great variety, is described crisply and effectively, and Dr Jones shows that its use is varied and changing: the western area, for example, is used for industry and artisan housing; the ridges have the more expensive houses, not inevitably on sand and gravel, for "who cares about the subsoil in Belmont if one is surrounded by the right neighbours" (p.225)? Old demesnes (landed estates) provided an attractive setting for suburban villas.

Perhaps every city is unique. Readers of this book having decided that it is not like Edinburgh, Glasgow or Dublin, will discover that there are resemblances after all. Wisely, the author handles the problem of general theories of city growth cautiously: fortunately he makes his views on the dreariness and inadequacy of much of the city's artisan housing abundantly clear. There are numerous maps and diagrams, though one wonders if those unacquainted with Belfast would have been helped by a general map—without much extra cost. More could perhaps have been said on transport, but space limitations are compelling. The book is well written, though some paragraphs are very short: it is excellently documented with a good index. Commending it warmly, one may hope that other cities may receive a comparable treatment.

T. W. Freeman

The Ports of the Exe Estuary, 1660-1860. By E. A. G. Clark. $9 \times 5\frac{1}{2}$. 2 maps, 3 photographs and numerous tables. Exeter: The University of Exeter Press, 1960. 25s.

In 1700 one-sixth of the national woollen export was shipped through the customs port of Exeter. Today there are only very minor ports on the Exe estuary, although the nineteenth-century warehouses on Exeter Quay can still be seen. In unfolding this account of the decline of trade, Dr Clark has provided an extremely useful contribution to historical geography, very clearly written, with an introduction which is a model of its kind.

Throughout the well-documented text it is easy to follow the headlines of the story: the navigational difficulties of the estuary on the one hand, and the declining industrial fortunes of the hinterland on the other. When the woollen trade had been finally dislocated by the Napoleonic Wars, it seemed that the Exe might become the route whereby coal, foodstuffs, and raw materials would be supplied to the South-western Peninsula. But by this time the estuary was presenting great difficulties to larger steam-driven vessels, and the railways assumed the rôle of chief supplier.

This is a most valuable account of a large estuary of the British Isles upon which a major port has not arisen, because of the lack of stimulus from the immediate hinterland since the nineteenth century. It is interesting to observe the complete contrast to the story of the Upper Mersey Estuary and Manchester as the following quotation shows: "Even if the Council had had large sums of money at their disposal, it is unlikely if they could have arrested the decline of an inland port with a limited hinterland, its only contact with the sea an expensive, outmoded canal leading from a shoal-filled estuary. ....the canal was no longer a source of civic pride, but a drain on the Borough Fund!"

J. H. Bird

Edinburgh Geology: Excursion Guide. Edited by G. H. Mitchell, E. K. Walton and D. Grant. 5 × 7½. Pp. XV + 222. 8 plates, numerous figures and diagrams. Edinburgh: Oliver & Boyd, 1960. 12s. 6d.

This excellent guide will be warmly welcomed by the many geologists—amateurs, students and established professionals— who wish to study the rocks of the Edinburgh district. It is thoroughly practical, and, after a general introduction, gives details of twenty whole or half-day excursions from Edinburgh. These range from the Ochils, Kirkcaldy and Elie, in the north, to the Eildon Hills, Dobbs Linn and Leadhills in the south. They have been carefully chosen to cover the main sedimentary and igneous rocks of the region and the glacial geology of the Pleistocene.

A description of each excursion is accompanied by first-rate geological maps with numbered localities and references to the relevant literature and to maps of the Ordnance and Geological Surveys. Walking distances and times are given, with recommendations of transport also. There is in addition a glossary of technical terms. As well as factual details about rock types, geological successions and structure, attention is drawn to problems of origin. Some hitherto unpublished work is included.

The authors and editors, Fellows of the Geological Society of Edinburgh, must be congratulated on producing, at a relatively low cost, an extremely useful and attractive guide. F. H. Stewart

The Making of the Broads. A Reconsideration of their Origin in the Light of New Evidence. By J. M. Lambert and J. N. Jennings, C. T. Smith, C. Green and J. N. Hutchinson. R.G.S. Research Series, Memoir No. 3. London: The Royal Geographical Society, 1960. 25s.

In text, maps, sections and air photographs, these five authors record their painstaking researches into the problem of the origin of the Norfolk Broads. With new evidence coming from the ecological studies of contemporary Waveney, Thurne and Bure Valleys, it was possible to consider seriously Broadland vegetation and with further stratigraphical evidence from the Broads as artificial, man-made features. The Broads were shown to have steep margins and rectangular profiles, to be floored with loose muds quite unlike the untouched 'ronds', and also to contain balks and islands of uncut peat reaching sometimes to present water level. It seemed certain that the Broads were in existence in Elizabethan times, but direct historical evidence was lacking. However, from old maps and medieval records, one of the authors was able to determine that peat-cutting was widespread in the region from the twelfth century to the fifteenth century, but particularly so in the thirteenth and fourteenth.

There remained the problem of dating and accounting for the decline of the peat-cutting industry. At this stage in the investigation two further collaborators throw light on the problem by a survey of the archaeological pattern for the region and an analysis of the evidence offered in deep excavations near the outfall of the River Yare. These demonstrated the presence of an open estuary with silt banks, in the Romano-British period, which subsequently shrank to river channels between drying silt-banks during the post-Roman marine transgression, followed by the slow submergence of the land from a level dated to the late-thirteenth century. It would appear that, until the post-Roman land emergence was well advanced, the population of the western part of East Anglia was comparatively dense, while that of Broadland was sparse. At this time, however, the slow eastward spread of settlers was augmented by the ninth-century Danish land-takings, and Broadland became densely populated at a time when the peats were fairly well-drained and uncut. The story was complete: the excavation of four centuries was halted by the progress of the later submergence and the deterioration of the natural drainage.

A fine example of how research in one discipline may come to the aid of research in another, this memoir will readily commend itself to a wide academic audience; its depth of scholarship, however, should not deter the general reader who is also a lover of the Broads. A. F. Williams

Across the Alps, Aerial Views between Nice and Vienna. By H. Annaheim, P. Eggenberg, A. Lunn and E. Schwabe. $11^3/_4 \times 9^1/_2$. Pp. (text) 54. 92 photographs. Bern : Kümmerly and Frey, 1959.

The sub-title "Aerial views between Nice and Vienna" aptly sums up the area covered by this collection of mostly monochrome oblique photographs of the Alps. The length and breadth of the Alps is embraced though, not unexpectedly, there is a bias towards the more popular parts of these mountains. However, the photographs have been thoughtfully selected to reveal the diversity in the Alpine landscape.

As a picture book this work is comparable in quality with other recent productions of a similar type. In this collection not all the photographs approach in quality the high standard set by the best, but all of them possess an interest or appeal which justifies their inclusion. In addition to the informative captions, several introductory essays deal with the Alps from various angles. Except for the concise description of structure and landscape these essays are enraptured rather than informative, but for the wider public the introductory text will perhaps help to create a frame of mind in which the photographs that follow may be enjoyed to the full.

Geographically the photographs contain many fine examples of land forms and of settlement in a mountain region and, for this reason, will provide a wealth of interest if carefully studied. The two end-paper maps give the location of each photograph and an indication of the structural regions of the Alps. For the photographer, brief technical details of each picture are also included.

J. D. Thompson

AFRICA

Our First Half-Century 1910-1960, Golden Jubilee of the Union of South Africa. $10^1/_2 \times 8^1/_2$. Pp. XII + 556. Numerous photographs. Johannesburg : Da Gama Publications, 1960.

Approximately one half of this anniversary volume is devoted to various aspects of life in the Union *(e.g.* government, religion, education, sport) and the remainder to the economy with a section given to each industry. Much information is presented in an encyclopaedic fashion. The emphasis throughout is on European South Africa and in the text and especially in the many excellent photographs there is little to indicate the presence in the Union of four non-Europeans for every one European. We are told that there is "political democracy" in South Africa, "..... a democracy in which every European man and women over eighteen, ... possesses the right to be registered as a voter" ! There is some reference to racial problems with the usual explanations and excuses for the situation. A poor ethnic map and an even worse economic map are contained in the end-papers and the only list of contents is annoyingly placed at the end of the book.

R. M. Prothero

Wild Life in An African Territory. By F. Fraser Darling. $5^1/_2 \times 8^1/_2$. Pp. VIII + 160. 1 coloured plate, 3 black and white folding maps. London : Oxford University Press, 1960. 25s.

The present book is an unofficial account of the travels and studies made by Dr Darling at the invitation of the Director of the Game and Tsetse Control Department of Northern Rhodesia. In its eight chapters, he describes his three main journeys through the territory, then discusses the ecology (giving a special chapter to the effects of fire), and finally describes the history and present administrative structure of the National Parks, Game Reserves, and Controlled Areas in the territory.

One is so used to finding the author's books of absorbing interest that it is perhaps only by comparison that this one seems a little disappointing to the reader who is not specially well informed on Northern Rhodesia. It is rather wearisome to find so many local terms unexplained or undefined *(e.g. kapata* wind) that one begins to lose the thread of the narrative. Nevertheless any who are concerned

with the enormous threat, not only to wild life, but to soil and fertility conservation in Africa (and, who, directly or indirectly, is not concerned?) should read this book, and be grateful that Dr Darling was commissioned to make the study.

F. H. W. Green

A Geography of Western Nigeria. By J. Grant. $9^3/_4 \times 7^1/_4$. Pp. IV + 95. 106 figures. Cambridge: Cambridge University Press, 1960. 4s. 6d.

This book is designed as an introduction to the geography of Western Nigeria for the junior classes in secondary schools in that country, but it is also of much value at home. It is written by a trained geographer with considerable residential experience of Western Nigeria and as such has an intimacy and reality that is often lacking in more high-powered studies. The book is excellently illustrated by both maps and photographs. It should be in all school geography libraries and many other circles could learn form it.

R. Miller

AUSTRALASIA

A Pilot Survey of Fourteen Villages in U.P. and Punjab. By P. K. Mukherjee and S. C. Gupta. $10 \times 6^1/_2$. Pp. 195. Delhi School of Economics. London: Asia Publishing House, 1959. 41s. 6d.

The key to this volume is provided by its sub-title "A Study in Methodology of Research in Rural Change". It is in fact a report on the pilot-survey carried out in 1954-5 on a number of villages in the Meerut and Bulandshar districts of U.P. and the Hissar and Rohtak districts of the Punjab with the object of testing research techniques and training field-investigators. It represents the first step of a programme of rural study initiated by the Agricultural Economics Research Station of the University of Delhi to supplement the wider National Sample Survey of village economics being carried out by the Government of India. The main problems faced by the investigators comprised the selection of units for study, the drawing up of schedules and questionnaires, and the assessment of the availability and reliability of economic information at both village and household levels. These issues are well treated and although the emphasis is on statistical analysis and there is a sad lack of cartographic treatment of the units studied, there remains much of interest to the geographer concerned with patterns of rural land-use, and problems of sample surveys on a regional basis. It is interesting to note that this research team abandoned both random sampling and regional representativeness as methods of selection, on the grounds that both raise too many side issues in the study of rural economic change, preferring instead to choose villages with distinctive economic characteristics, sensitive to forces of change and capable in periodic surveys of giving answers to specific questions.

W. Kirk

New Zealand: A Regional View. By K. B. Cumberland and J. W. Fox. $8^3/_4 \times 5^3/_4$. Pp. 280. 56 plates. 60 maps. Christchurch: Whitcombe & Tombs, 1959. 18s. 6d.

The study of the geography of New Zealand has long been hampered by the dispersal of detailed information in various periodicals; the bibliography at the end of this book shows how many and varied are the sources drawn upon.

According to the introductory chapter, the aim of geography is "to interpret, explain and account for the likenesses and differences between places". After a short chapter on systematic geography — probably the least satisfactory in the book — the personality of each region is described and the factors which go to make up that personality are examined. Particularly worthy of comment are some of the vivid word-pictures of landscapes and the admirable accounts of the importance of historical development. Perhaps the lessons are sometimes driven home with a blunt instrument; to the authors could be commended the exercise of re-writing their theses without using the words "distinctive character" more than once in each chapter. Sometimes, too, there is an impression that the original

divisions chosen are over-justified: Taranaki and Marawatu do not wholly "hang together", and Central Otago, the area with the most distinctive character of all, is included with the High Country.

The reader is sometimes left with an impression that the accent is too much on description. The horror of determinism in the minds of New Zealand geographers, in a young country where economic factors usually outweigh physical ones at the present stage of development, and when the early days of geographical study were heavily weighted towards geomorphology, has left a tendency to underrate the impact of various factors upon each other and to give a rather scant treatment to the physical background. The most lucid chapters, like that on Eastland, are those where the physical background is most clearly described, while in the case of Fiordland — a region almost untouched by man — the lack of attention to physiography is striking and lamentable. This is in spite of the fact that the eleven regions described are really physiographic divisions of the Dominion.

It is a pity, too, from the point of view of the overseas reader, that insets of large-scale maps are omitted; for the statement that large-scale sheets are readily available certainly does not apply outside New Zealand. The smaller-scale maps, though abundant are not always clear and references are often made in the text to places lying just outside the region and not shown on the relevant map. The reader needs to refer to a good atlas, such as the recently published *Descriptive Atlas of New Zealand*. Functional maps of the four main centres would have eliminated a good deal of unnecessary and confusing text.

Nevertheless, virtues outweigh shortcomings, and this is without doubt the most important general study of New Zealand geography yet produced.

E. L. Elliott

BIOGEOGRAPHY AND GEOMORPHOLOGY

Trees and Bushes in Wood and Hedgerow. By H. Vedel & J. Lange. Translated by C. H. R. Hillman & H. L. Edlin. 7½ × 5. Pp. 224. Illustrated in colour and black & white. London: Methuen & Co Ltd., 1960. 16s.

This is more than merely another 'tree-spotters' guide. The book offers a scientific and artistic introduction to the study of trees and shrubs, both wild and cultivated, likely to be found in Britain, or, in fact, Northern Europe. The normal methodical 'flora' approach is adopted and yet each page reveals a much more imaginative style than is usual in such a book. The authors have recognised the need to represent scale adequately when depicting trees and this has been done most ingeniously and interestingly. The layout of each page too is varied so that no feeling of repetition is allowed to creep in. After the systematic illustrated flora, which includes some 120 trees and shrubs a further eighty pages are given over to full textual descriptions of each tree or shrub. This section includes information about the botanical characteristics, the names and the uses of the plants illustrated. In addition the geographical distribution of each tree and bush is shown by a series of simple maps. It is a pity that more attention had not been given to this aspect of the book as here the authors have been content with very generalised drawings. Further sections of the pocket-book explain the botanical structure of the wood of trees and some of the uses to which it is put by foresters and carpenters. The development of the Northern European forest is very well shown in another section, by using simple drawings which relate the various climatic and tree-cover periods to archaeological stages in civilisation.

The book will be of use to many lay and professional geographers both in field-work and in the library. Its price will unfortunately preclude its use in many schools but it might be hoped that its attractive presentation will offset this disadvantage to the classroom so that school libraries will make a point of having it on their shelves. It should certainly serve as a guiding light to any geography students, without botanical knowledge, who find themselves lost in the bio-geographical forest.

Published originally by *Politikens Forlag*, Copenhagen, the book has been adapted for use in Britain and will certainly justify the authors' claim "to spread scientific knowledge of trees and shrubs among all who encounter them".

I. A. G. Kinniburgh

Salt Marshes and Salt Deserts of the World. By V. J. Chapman. 10 × 6½. Pp. V + 392. 102 figs. 45 plates. Plant Science Monographs. London: Leonard Hill Books Ltd, New York: Interscience Publications Inc., 1960. 95s.

This monograph is the first of a proposed series on various aspects of Plant Science under the general editorship of Professor Nicholas Polunin. As an attempt to review and summarise the present state of knowledge about the nature and distribution of halophytic vegetation it must be commended, and as such it will provide a most useful reference book to the subject. Professor Chapman has brought together a formidable amount of literature (of which his own researches form not an inconsiderable part) published on various aspects of the subject from many parts of the world.

The first four chapters provide a general introduction to the character and distribution of salt marsh and desert vegetation together with a detailed analysis of those three most important environmental factors — physiography, water and soil — which affect their nature and distribution. The five following chapters are devoted to a description of the salt marshes and deserts of the world. These are disappointing since little attempt is made towards the generalisation and synthesis that space would seem to demand, and they degenerate into a disjointed plethora of facts grouped for convenience under seemingly arbitrary regions — British Isles (two chapters); Arctic and Continental Europe; Mediterranean and Australasian with Eurasian salt deserts (and including Africa); New World. The chapter considering ecological, floristic and life-form characteristics, however, goes some way towards a more rational treatment and classification.

The monograph ends with an analysis of the physiology of halophytic vegetation —which might well have *preceded* the regional treatment—and a useful concluding chapter on the economic uses of salt marsh and desert. The book is illustrated liberally with good black and white plates (half from British sites) and an extensive bibliography.

The whole however suffers as a result of the difficulties inherent in a study which endeavours to combine the results of detailed research with a general summary of both the systematic and regional aspects of such a diverse and discontinuous field. The problem of limitations of space has been answered by a high degree of compression, resulting unfortunately in a disjointed and 'note-like' style rather than by selection and generalisation. One feels that in an effort to combine as much detail as possible with as comprehensive a survey as possible the author "falls unhappily between two stools". J. Tivy

Geomorphology. By B. W. Sparks. 8¾ × 5½. Pp. XX + 371. 51 plates and 201 figures. London: Longmans, Green & Co. Ltd., 1960. 37s. 6d.

This is a very useful textbook for first-year geography students in universities and for teachers of sixth-year classes in schools. It is well illustrated with maps, diagrams and photographs, some of the latter showing excellent examples of certain types of landforms. Approximately half of the photographs are of parts of Scotland, the island of Arran being particularly favoured. The style of writing is clear and the evidence for opposing points of view is set out lucidly and conservatively. The Davisian cycle is retained as a basis for the discussion of landforms. A valuable chapter on the development of slopes is included, but the chapter on changes of climate is very brief. A chapter on desert and savanna landforms and two on glacial landforms are incorporated, but there is no chapter on landforms of the humid tropics. On the whole the book follows traditional British lines and will be widely used in Britain. J. B. Sissons

Coastal Changes. By W. W. Williams. 8½ × 5½. Pp. XVIII + 220. 48 maps and figs. 8 plates. London: Routledge and Kegan Paul Ltd, 1960. 28s.

For almost half-a-century the classic manual on shoreline morphology has been Johnson's *Shoreline Processes and Shoreline Development*, yet such have been the advances in the study of coastal phenomena and processes that this work

is now in many respects outdated. Recent volumes by King and Guilcher have remedied the situation but left a gap for the non-technical reader which the present volume by W. W. Williams goes a long way to fill. It presents the modern interpretations of coastal processes in non-mathematical fashion, although the important formulae are included in appendices.

The concentration in this volume is on process and change with the authority of many years of laboratory and field investigations behind it, including work during the war on problems connected with amphibious warfare. There is a most useful chapter on observational methods requiring little instrumentation or financial outlay which one hopes might stimulate more investigations into the nature of change on our own Scottish coasts. For the student it provides a useful basis of knowledge, on which he can build for specialisation if necessary, and for the teacher and general reader an important corrective to the older and oversimplified, sometimes erroneous, statements which still appear in text-books. K. Walton

ATLASES

Oxford Regional Economic Atlas. The Middle East and North Africa. Prepared by the Economist Intelligence Unit and the Cartographic Department of the Clarendon Press, Oxford. $7^3/_4 \times 10^1/_4$. Pp. VIII + 135. 41 maps. London: Oxford University Press, 1960. 42s.

This atlas follows the familiar pattern of its series, half the volume consisting of reference material and considerable textual information also being inset on the map pages. The climatic diagrams, including precipitation dispersion and water balance according to Thornthwaite's method, merit particular mention. The maps with flow diagrams for the Nile, Tigris and Euphrates should be found especially helpful. It is again surprising to find that the agricultural maps have been constructed from statistics for only two years (1953-1954), the more so in an area with notoriously variable yields. The map of agriculture in Sudan stands out for its clarity and general aesthetic quality in contrast to the crowded or unpleasantly coloured maps on some of the other pages. Notably informative map pages are those on oil production and concessions. C. J. Robertson

Atlas of the Arab World and the Middle East. By Macmillan, with an introduction by C. F. Beckingham. $13^1/_2 \times 10$. Pp. 69. Maps 40 pp. 42 photographs. 2 end-paper maps. London: Macmillan & Co., 1960. 35s.

This useful volume contains forty pages of maps in colour, produced by Djambatam of Amsterdam, another twenty pages of black and white photographs interspersed with Professor Beckingham's introduction, and a full index. It deals with the area from Morocco to Turkey and Iran, and includes the Sudan in the South. For each of the main areas, besides a physical-political map, there are maps showing rainfall, agriculture and mineral distributions, and sometimes also temperature, natural vegetation and industries, as well as specific agricultural products. There are plans of the main towns, and two general maps showing political changes since 1850. All this—and the attention given to refugee camps and oil concessions — shows this atlas to be a valuable aid to students of the modern Middle East. Even medievalists, however, will find it useful, since, apart from the maps of the almost changeless physical features of the area there is a general map on the back end-paper of the world of Islam in the Middle Ages. The Introduction contains a competent sketch of the history of the Middle East. W. M. Watt

Atlas Polski. $17^1/_8 \times 13$. Size of map-sheets $23^3/_8 \times 17^5/_8$. In 4 folders, 6 sheets of maps in each folder. Warsaw: Certralny Urzad Geodezji i Kartografi, 1956.

Since the second world-war, many new national atlases have been produced: these publications are always interesting and, in most cases, they have been very

carefully produced with little regard to cost. The *Atlas of Poland* does not quite belong to the ranks of these new publications.

The work on the *Atlas of Poland* started just after the war, in November 1945. However, due to many changes in the editorship, the original scheme of the Atlas has been only partially carried out and the completed sections comprise the folders under review. Since 1956, plans for the preparation of the *Atlas of Poland* proper have been going ahead. The new atlas is to be prepared by the Institute of Geography of the Polish Academy of Sciences. The format of the new atlas will be altered to measure $19^{5}/_{16} \times 23^{1}/_{4}$ inches and it is planned to have 454 maps on 120 sheets. It is to appear in three languages, Polish, English and Russian.

To return to this temporary *Atlas of Poland*, one must say that, in spite of the poor quality of the paper, the quality of the work is very satisfactory. Each sheet consists of a map area and the margin area which is filled in with text or explanation of the symbols used. The maps are at a scale of 1 : 2M or smaller. Each map has been prepared separately by various geographers and specialists in each given subject.

The first folder contains six sheets the first of which gives a few examples of the early maps of Poland, the second provides a general map of Poland and the others cover soil, geology (drift), geomorphology and gravitation. The second folder deals with orography, drainage basins, geobotany, vegetation and zoogeography. The third folder is concerned with various aspects of climate and the fourth deals with the location of Poland in relation to Europe and the rest of the world ; geology on three maps (solid, tertiary and quaternary drift) and meadows and pasture lands. The last map in this folder is an interesting one, giving the distribution of macro-seasons in Poland as determined by the blossoming time of certain chosen plants, for example, the pre-spring season is determined by the blossoming of the hazel, *Corylus avellana*, and the map shows that it occurs throughout the country between February 25th and April 1st. J. J. Klawe

Atlas of European Birds. By K. H. Voous. $14 \times 10^{1}/_{2}$. Pp. 284 with 419 maps and 355 gravure plates. Edinburgh : Thos. Nelson and Sons, Ltd, 1960. 70s.

This Atlas, prepared by the Professor of Zoogeography at the Free University of Amsterdam, is unique in affording a comprehensive zoogeographical survey of all the species of birds breeding in the British Isles and Europe west of the Ural Mountains.

The text gives a clear and concise account of each of the 419 species of European breeding birds under the headings of faunal type, distribution, habitat, food, nest, and migrations. The maps, closely linked with the text, give an insight into zoogeographical problems involved by clearly indicating the breeding range of each species—and in these lie the book's greatest value to ornithologists. The photographic plates have been chosen from the work of well-known bird photographers from many countries, and are of a high standard.

The Atlas is remarkably good value; it is not only a handsome picture book but an authoritative work of reference. G. Waterston

Nelson's School Atlas. Edited by J. W. Watson. $11^{1}/_{4} \times 8^{3}/_{4}$. Pp. 16 (text) + 48 (maps). Edinburgh : Thomas Nelson & Sons Ltd, 1960. 12s. 6d.

It needs courage to undertake the tremendous task of making a new atlas and to try out new cartographic ideas. The present volume designed for schools brings fresh ideas to both the layout and to the design of the maps. It uses colour well and sets a high level of colour printing and register. A quick glance through its pages suggests that it has many similarities of style with the modern Swedish atlas-making school.

After an attractive introductory section using diagrams, maps, photographs and text, one passes to the main body of the maps. Unfortunately this has its failings. The use of a pale-yellow tint on most of the maps produces a clean if monotonous appearance, while the indeterminate brown hill-shading fails to give an adequate and clear impression of relief. On pages 6/7, the Tarporley Ridge is almost as prominent as parts of the northern Pennines, and this technique fails

almost completely in the plains of Russia. Omission of relief from the larger-scale maps of the British Isles is, however, a serious drawback to their use among students. One wonders whether the brightly coloured continental maps of vegetation and relief do not belong better in a glossy magazine: they are rather too generalised and the use of bright colours in the relief sequence makes them difficult to appreciate. There are also regrettably a number of compilation errors. The most widespread one is in the choice of railways, where many vital trunk-routes are left out but insignificant local lines included. The "edge of the continental shelf" marked in the Black Sea is a little disconcerting. The use of the same symbol for the northern limit of agriculture and the isohyet of under 10 inches confuses. Identical type size and face and the same symbol for both Ballater and Balmoral is unfortunate. Spellings also need checking, notably in the transliteration of Russian names (some of which appear in old and discarded forms), and in Europe (e.g. Mönchen Gladbach is now the correct form).

It is nevertheless easy for a smug reviewer to sit in his easy chair and pick out the few errors — it is far harder for a harassed editor to prevent the gremlins getting in. Let us hope that this will be followed quickly by a second edition where these growing pains have been ironed out. R. E. H. Mellor

CARTOGRAPHY

Aviation Cartography. By W. W. Ristow. $10^1/_4 \times 7^3/_4$. Pp. 245. 2nd Edition. Map Division, Reference Department, Library of Congress, Washington, 1960. $1.75.

This second, and very much enlarged, edition of *Aviation Cartography* symbolises the advances made in this specialised form of mapping, particularly in the decade 1949 to 1959. The bibliography, which forms the core of the work, lists 770 items, over 200 more than the 1st edition. Items are quoted from American, French, German, British, Dutch, Polish, Portuguese, Italian, Swedish, and Russian sources. This edition is published on the occasion of the 50th anniversary of the publication of the first air-map and it is interesting to reflect on the constantly changing assessment of the problems involved in this type of mapwork. So fast and so far-reaching indeed are these changes that one feels that a publication of this sort will shortly require to be published in periodical form in order to keep pace with change. I. A. G. Kinniburgh

Reading Topographical Maps. By A. H. Meux. $10 \times 7^1/_2$. Pp. 84. Numerous maps, figures, plates. London: University of London Press Ltd, 1960. 10s. 6d.

This book, appearing as it does at a time when a new emphasis is being laid on topographical map and aerial-photograph reading in Ordinary Level Geography, is worthy of the attention of every teacher of geography. The order of presentation has been carefully planned so that the exercises graduate from the simple, but essential, first principles to the complex problems of relating human activities to the physical background as shown in Ordnance maps and aerial photographs. The author obviously appreciates the difficulties of teaching map-interpretation and, by skilful arrangement of illustrative material and by using methods known to the experienced teacher, he succeeds in simplifying these obstacles. In the Introduction, for example, an explanation of the National Grid of the British Isles precedes the instruction in its use. Exercises, following immediately after every stage of instruction, reinforce the learning process. The small but useful diagrams illustrating the contours of certain physical features are identified with real locations. Thus the pupil is indirectly reminded that glacial features occur in North Wales and the Lake District. Special attention is paid throughout the book to extending the vocabulary of the pupil and in the many exercises opportunity is given for using these terms. The challenging arrangement of the one inch O.S. Map and the oblique aerial photograph of Dolgelley (pages 18 and 19) shows up vividly the common errors in correlating maps and photographs. No pupil could fail to be stimulated by the choice and the arrangement of these photographs. The careful editing and excellent indexing of the contents make the book especially useful to

the teacher who is working with individuals or small groups within a composite class. The average pupil would be able to work on assignments with the minimum of assistance from the teacher. Finally, the book commends itself to all teachers of geography by incorporating within one book, O.S. 1 inch; 2½ inch; 6 inch maps; oblique aerial photographs and exercises, thereby simplifying supply and storage problems.

The main criticism for the Scottish teacher of Geography is the absence of references to Scottish features, but this is perhaps understandable as all examples are related to the maps and photographs used. It is for the teacher to recognise this omission and rectify it in class teaching. This book can confidently be recommended for use, not only at Ordinary Level Geography, for which it is more than adequate, but as a basis for practical mapwork in the Scottish Certificate of Education, Higher Level, Geography. H. E. Jamieson

GENERAL AND EDUCATIONAL

Land Ownership and Resources. By S. Zuckerman *et al.* 9 × 5½. Pp. 136. 8 figs. 3 tables. The Department of Estate Management, University of Cambridge and Cambridge University Estate Management Club, 1960. 15s.

This volume embodies lectures, given at Cambridge in the summer of 1958, designed to set problems of land ownership against the general background of national policy. It benefits from the Zuckerman and Franks reports and indeed for the geographer the chapter by Sir Solly Zuckerman on the use of natural resources, particularly agricultural and forest, an admirably concise discussion, is the most directly profitable. Sir Solly emphasises the need to apply economic, social and political tests in deciding whether to use valuable resources of capital and technology to agricultural or forest production or to the many alternative industrial uses. He bears in mind the quite unusual existing pattern of land use and population in Britain, where, too, much of the land can be used for agriculture and forestry only if industry is sufficiently productive to provide the resources. Miss Ruth Cohen points up the discussion with a trenchant consideration of strategy, amenity, sociology and the terms of trade. Other chapters deal with town and country planning, the rights of the individual, estate ownership, building economics, while, to provide some comparisons with British conditions, there is a chapter on land development in the Netherlands. C. J. Robertson

Norway. By W. R. Mead. 8½ × 6½. Pp. VIII + 100. 30 maps, diagrams. 27 photographs. *Australia.* By A. J. Rose. 8½ × 6½. Pp. 102. 19 maps, diagrams. 44 photographs. "How People Live Series". London: Educational Supply Association Ltd., 1959. 8s. 6.

In attempting, through sample-studies, to create and convey to children the 'atmosphere' of countries which neither they nor their pupils have visited, teachers often find source material hard to come by. Although too dear for most budgets as class-texts, these books meet this teachers' need and should also prove attractive in school libraries. The book on Norway shows that country through the lives of six young Norwegians, giving an extremely intimate approach, and is written in language appropriate to 10 to 13 year-olds. The style of the book on Australia suits a rather older age-group. Less emphasis is put on the three sample-families involved and more space given to aspects of the life of Australians as a whole. A glossary, bibliography, and list of Common Ground filmstrips complement the many photographs and drawings in each case. A. A. M. Hogg

North America. By A. W. Ryans. 9¾ × 7¼. Pp. 64. Illustrated. 5s. *The Southern Continents.* By A. W. Ryans 9¾ × 7¼. Pp. 96. Illustrated. 6s. 6d. "Bell's Concise Geographies Series". London: Bell & Sons Ltd, 1960.

These are the first two titles in a new series for schools which sets out to present world geography, concisely and accurately, to pupils between the ages of twelve and fifteen. Both books are uniform in size, style and, especially so, in

presentation. The text is very formal and factual, heavy type being used for headings and fainter type for questions.

The historical background is sketched in briefly and the usual features of general geography stated. Thereafter, the chapters follow a regional division, sometimes by states, sometimes by broad areas, as in Africa and North America. There is a great abundance of photographs and sketch-maps, related to the text, and a profusion of questions is interspersed throughout. Nowhere is an attempt made to analyse the content of a photograph; this is a pity since many are well-chosen, though generally they are dull and small and some serve no purpose whatsoever. Sketch-maps are bold and clear and only a few warrant the familiar accusation of being detail-packed.

It is open to question if the statement made by the author in his Preface is true, that "the variety provided by the breaking up of almost every page into maps, texts, questions and photographs should help to maintain interest." The many exercises might help pupils to fix facts in their minds, but the sameness of the work must have a deadening effect. Teachers want to teach facts better and to achieve a worthwhile attitude in their pupils' enquiring minds. It is doubtful if these publications will help them to do this.

Rarely has such a wealth of geographical facts been assembled in such slim volumes. Rarely can geography have been presented more uninspiringly. If the conciseness of the material is a virtue, then this series has a *raison d'être*. It would appear to have no other justification than the production of 'cram' volumes for examinations.

A. Chalmers

North America, Europe and the British Isles. General School Geography, Volume III, By J. S. Hobbs. $5\frac{1}{2} \times 8\frac{3}{4}$. Pp. 224. 144 figs. London: E.U.P., 1961. 9s. 6d.

Those who may have read the first two volumes in this series may be disappointed that this volume is not so good. Its weakness is the section on the British Isles, where the author has approached his task in a manner, which, although it may solve some problems, is not entirely satisfactory. He has abandoned regional study and discusses instead only selected topics, *viz.* climate, Highland and Lowland Britain, coasts and industry. Even if allowance is made for the fact that the British Isles are touched upon in Volume I, this cannot be regarded as a complete study.

The chapters dealing with North America and Europe are sound. Northern Canada as a region is very well done and the economic summary of North America is most helpful, but consideration ought to have been given to Eastern Canada as a region. Central and Mediterranean Europe are adequatley covered: U.S.S.R., like France, the Low Countries and Scandinavia, merits a chapter but it is brief in comparison with North America.

Maps and diagrams are of a high standard. The text is easily read although some readers may take exception to the practice of bracketed questions designed to promote revision and cross-reference. The emphasis is that of an English writer — for instance the Scottish Highlands and Southern Uplands receive but scanty mention as "other areas of Highland Britain" after protracted discussion of the Lake District, the Pennines and Dartmoor. The photographs are a particularly attractive feature: they have reproduced well and are original in selection.

Teachers will be unable to use this book without the previous volumes and even then will feel obliged to augment regional study of the British Isles from their own resources.

H. Paul

GEOGRAPHICAL FILM STRIPS

The following list, giving title, number of strips, and number of frames in brackets, indicates strips, with relevant teaching notes, available to members in the Society's library.

Transport in the East, 1. (32): *Eastern Crafts,* 1. (33): *North East Sudan,* 1. (48): *The Latuka Tribe of Southern Sudan,* 1. (42): *The Baggara Tribe of Central*

Sudan, 1. (40) : Mapstrip No. 1, *The British Isles*, 1. (24) : *Egypt To-day*, 1. (41) : *Everyday Life in Alpine Switzerland*, 1. (34) : *Various Food Plants and Textile and Fibre Plants* 2. (36) (31) : *Earthquakes*, 1. (21) : *Peoples of the Fjords*, 1. (28) : *Air Routes of the World, England to Egypt*, 1. (28) : *The Ascent of Everest*, 1. (40) : *Through Nepal to Everest*, 1. (49) : *Growing Up, Progress in Gold Coast Education*, 1. (36) : *The Regional Geography of Italy*, 2. (40) (43) : *The Story of Life, The Beginnings of Life*, 1. (43) : *Palestine Past and Future*, 1. (31) : *Geography of Chile*, 1. (53) : *India*, 1. (46) : *Sugar Growing and Refining*, 1. (25) : *Eastern England*, 1. (41) : *The Mole Gap Area and Box Hill*, 1. (34) with map : *Central Lowlands of Scotland*, 1. (40) : *South Wales*, 1. (48) : *Lower Severn Basin*, 1. (53) : *Regional Geography of the Netherlands*, 1. (40) : *Regional Geography of Fiji*, 1. (39) : *The Geographical Background to the Bible, Egypt*, 1. (30) : *The British Caribbean*, 1. (42) : *A Sahara Journey*, 1. (36) : *The Commonwealth Trans-antarctic Expedition*, 1. (44) : Everyday Life Series, *Alpine Switzerland*, 1. (34) : *Samoa*, 1. (54) : *The East*, 1. (40) : *Cyprus*, 1. (42) : *Italy*, 1. (41) :

Educational Productions Ltd, Wakefield.

For several years the Society has been adding film strips to its library and a group of titles was reviewed in the *Scottish Geographical Magazine*, Vol. 71. (2), September, 1955. The group listed here should be added to the previous list and teachers, or others, interested in newer titles will find these in future included with the Library Additions Lists inserted in the magazine from time to time. Reviews will also continue to appear wherever space permits.

Filmstrips now form an integral part of the study of geography and it is vital that they themselves must be properly planned and co-ordinated to this end. Teachers of geography will be glad to learn that most of the filmstrips under review have been edited with this aim in mind and are not merely unsystematic collections of separate unrelated photographs. To assist the teacher in gaining maximum value from the strips, the accompanying scripts give a brief, descriptive list of the frames of each strip at the beginning before setting down the greater detail of each frame separately. In these texts there is however great variety in quality and it is a pity that more uniform standards could not be applied to this aspect of the strips.

Within the strips themselves the quality of photography is high and the almost universal use of colour gives a very real picture. Few strips, in fact, now appear in black and white and it is somewhat disappointing to find this used in the *Story of Life* strip. The medium is, however, carefully used and many of the frames provide excellent studies for classes considering fossil evidence in the geological time-scale. Colour is used conspicuously well in most of the others strips. Those of *East England* and the *Regional Geography of the Netherlands* have been made from consistently high quality colour pictures. Similarly the strip describing *Sugar Growing and Refining* is full of bright colourful scenes from Mauritius and the West Indies. The quality of picture does not fall when sugar-beet growing areas in temperate and less sunny parts of the world are shown. Apocryphal as it may seem, the chief fault of this strip lies in the use of several frames to show 'human interest' which could well have been incorporated in other frames showing, for example, cane growing or the growers' houses. Shots of this nature are, on the other hand, expected in the Everyday Life series. The *Everyday Life in Italy* strip is generally a useful one, even if colour quality is below average standard, and it covers the country, including the neglected south and Sicily. The strip serves as an introduction, for younger pupils, to the strips devoted to regional examination of Italy. Film strips should be able to bring to life parts of the world, including parts of our own country, which are not personally well known to either pupil or teacher. It is a pity, therefore, that the most detailed regional strip in the group under review, that depicting the *Mole Gap Area and Box Hill*, fails to do this. Here the authors appear to have fallen into the trap of over-familiarity. True, the strip, like most of the others, is prepared for the London County Council, but it is also expected to be used by pupils who have little or no personal knowledge of the area in question. One feels throughout its use, that the viewer is expected to know the area well *before* seeing the strip. To its credit, however, the strip

does include some very well-prepared frames, some of which are combined photographs and annotated sketches of the same view. This style of presentation is exceptionally valuable in landscape interpretation.

Generally speaking these film strips are very worthy of their place in the modern teacher's equipment. They will admirably supplement the more traditional media of books and maps. It is curious that, in many cases however, the strips contain at best only second rate maps. The majority of these are gaudy and confusing and bear type which is hardly legible. The value of the strips lies in their ability to convey a dynamic impression of scenes which are often difficult to express in text. In this respect these strips bear out the truth of the often quoted saying of the Chinese that 'one look is worth a thousand words'.

R. Paul and I. A. G. Kinniburgh

ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

PROCEEDINGS

Meetings of Council were held on 16th December, 1960 and 20th March, 1961.
Obituary: Sir Hugh McPherson, K.C.I.E., C.S.I., Vice-President, 1930-1960.

LECTURE SESSION 1960-61

Edinburgh: Usher Hall — Professor J. Wreford Watson on "British Columbia, Land of Contrast", on 19th January. Eric Newby on "A Short Walk in the Hindu Kush" on 16th February. Alan Moorehead on "The Nile" on 16th March. *Central Hall* — John Black on "An Asian Journey" on 25th January. Norman G. Brown on "Austrian Tirol and Bavarian Alps" on 8th February. C. A. Halstead, B.Sc., on "Between tree-line and snow-line in Southern Norway" on 22nd February. Alan Evans on "Through Yugoslavia to Greece" on 8th March. James Hossack, M.A., B.Com., F.E.I.S., on "New Zealand Revisited" on 22nd March. *The Society's Rooms* — B. R. S. Megaw, B.A., F.S.A., on "House types in Scotland" on 26th January. A. C. Marles and R. H. P. Dugmore on "Ground Survey" on 3rd February. H. Fairhurst, M.A. Ph.D., on "The Clachan of Lix and the period exemplified by it" on 23rd February.

Glasgow: St Andrew's (Grand) Hall — Professor J. Wreford Watson on "British Columbia, Land of Contrast" on 18th January. Eric Newby on "A Short Walk in the Hindu Kush" on 15th February. Alan Moorehead on "The Nile" on 17th Mach. *St Andrew's (Berkeley) Hall* — John Black on "An Asian Journey" on 26th January. C. A. Halstead, B.Sc., on "Between tree-line and snow-line in Southern Norway" on 23rd February. James Hossack, M.A., B.Com., F.E.I.S., on "New Zealand Re-visited" on 23rd March. *The University Geography Lecture Theatre* — B. R. S. Megaw, B.A., F.S.A., on "House types in Scotland" on 25th January. H. Fairhurst, M.A., Ph.D., on "The Clachan of Lix and the period exemplified by it" on 15th February. *The Burlington Restaurant* — Lecture Lunch — 25th March.

Aberdeen: Y.M.C.A. Hall — Professor J. Wreford Watson on "British Columbia, Land of Contrast" on 16th January. Lady Wheeler on "The Walls of Jericho" on 13th February. James Hossack, M.A., B.Com., F.E.I.S., on "African Safari" on 13th March.

Dundee: St Paul's Hall — Professor J. Wreford Watson on "British Columbia, Land of Contrast" on 17th January. Lady Wheeler on "The Walls of Jericho" on 14th February. James Hossack, M.A., B.Com., F.E.I.S., on "African Safari" on 14th March.

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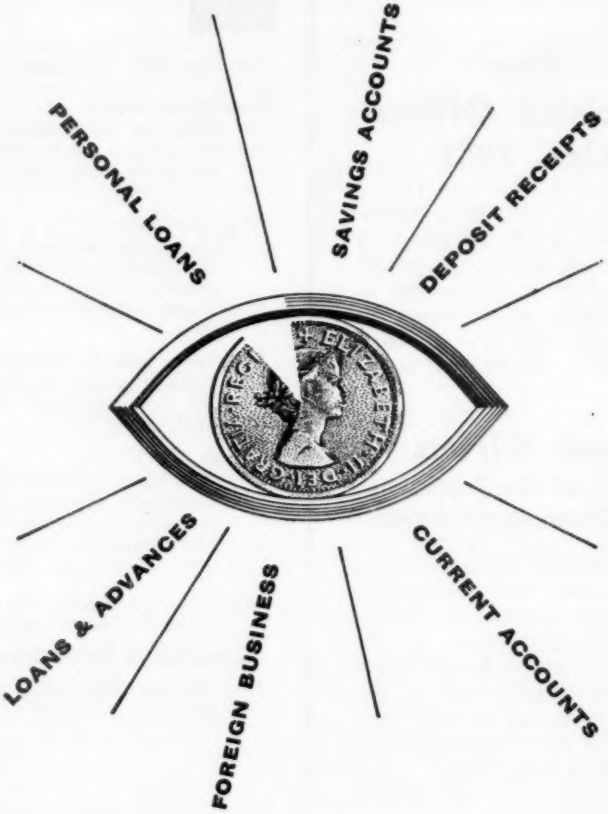

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